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THE GATEWAY OF OLD SQUARE, LINCOLN'S INN.

By A. C. RANYARD.

THE picturesque old buildings shown in the plate were the centre of very active life during the eventful Commonwealth Period. In the rooms on the ground floor of No. 24, entered by the doorway at the base of the tower in the corner at the right hand of the picture, Mr. Secretary Thurloe, the trusted friend and active business adviser of Oliver Cromwell, had his chambers. Here he was, no doubt, frequently visited by the Latin Secretary, John Milton, and here, we learn from Samuel Morland, the clerk or under-secretary of Mr. Secretary Thurloe, the Protector came to consult on State secrets.

At No. 23, on the south side of this little court or square, which was formerly called Gatehouse Court, Edward Lenthall, afterwards Speaker of the Long Parliament, occupied rooms for some years on the third floor. Thomas Wentworth and William Prynn also seem to have had chambers in the same block overlooking the kitchen garden, though their rooms cannot now be identified.

According to a story told in the life of Morland, Oliver Cromwell visited Thurloe late one night at his chambers, and explained to him a design which had been formed to inveigle Charles II., then an exile at Bruges, and his younger brothers, the Dukes of York and Gloucester, into his power. A treacherous intimation was to be conveyed to them through the agency of Sir Richard Willis, that if on a stated day they would land on the coast of Sussex they would be received by a body of five hundred men, to be augmented on the following morning by two thousand horse. Had they fallen into the snare, all three were to have been shot immediately on reaching the shore.

Cromwell, after discussing the affair with Thurloe for some time with the utmost secrecy, became aware that a clerk was lying with his head upon his arms, as if asleep, at his desk in the little room at the back. Fearing lest he should have been overheard and the plan might be disclosed, he drew his dagger, and would have dispatched the slumberer on the spot, but for the assurance of Thurloe that his clerk was unquestionably asleep to his certain knowledge, having been sitting up for two nights.

Morland, however, was not asleep, and disgusted with the proceeding, or seeing an opportunity to make capital out of the incident, he determined to divulge the plot to the King, which he did through Major Henshaw, who was then imprisoned in the Tower. The King, having been cautioned, answered that "he could not be ready as soon as the appointed day," which raised some suspicion that the plot had been discovered. Sir Richard Willis again wrote, urging the King "to use expedition, and not to lose so fair an opportunity for his happy restoration." The King answered that he was not very well, or something that appeared so frivolous that Willis concluded that the whole plot had been discovered, and suspected Morland, who soon afterwards thought it better to leave England and join the King at Breda, in Holland, where he was knighted, and soon afterwards made a baronet, facts which seem to confirm a story which otherwise might be considered improbable.

After the restoration Sir Samuel Morland was made "Master of Mechanics" to His Majesty, with a pension of £400 a year as an "honourable badge of his signal loyalty," an appointment which does not seem to have involved any very serious responsibilities, while the salary was four times as great as that given by Charles II. to Flamsteed, the first Astronomer Royal, for the maintenance of himself as well as Greenwich Observatory.

Sir Samuel Morland was, however, a real mechanician and experimenter. He greatly improved, and is frequently spoken of as having invented the fire-engine, with its air-spring and continuous flow of water. But his greatest title to honour is the advance which he made towards the invention of the steam-engine. In the Harleian collection of manuscripts is a treatise by Sir Samuel Morland, entitled "Elevation des eaux, par toute sorte de machines, reduite à la mesure, au poids, et à la balance: Presentée à sa majeste tres Chrétienne 1683." It contains a short tract on the steam-engine, entitled "The Principles of the New Force of Fire, invented by Chev. Morland in 1682, and presented to his most Christian Majesty in 1683." In this tract the steam-pump is explained in a manner which seems to show that Morland must actually have constructed steam-pumps, and that he must have experimented with considerable accuracy as to the expansion of water on its conversion into steam. He says:—

"Water being converted into vapour by the force of fire, these vapours shortly require a larger space (about 2,000 times) than the water before occupied, and rather than be constantly confined would split a cannon. But being duly regulated according to the rules of statics, and by science reduced to measure, weight, and balance, then they bear their load peacefully (like good horses), and thus become of great use to mankind, particularly for raising water, according to the following table, which shows the number of pounds that may be raised 1,800 times per hour to a height of six inches by cylinders half filled with water, as well as the different diameters and depths of the said cylinders."

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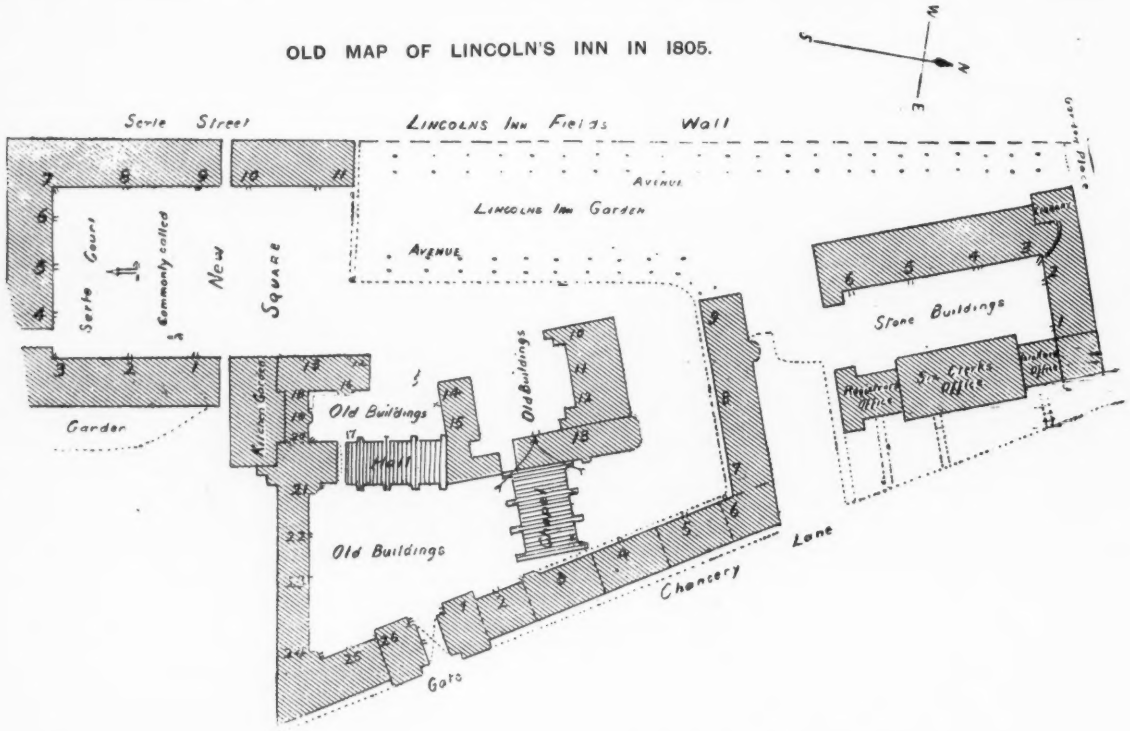
The idea of using steam for useful purposes had no doubt been in the air since the Marquis of Worcester's publication (1663), but there is no evidence that he carried the project into execution; and these experiments, if made prior to 1682, were nearly ten years earlier than those of Dr. Papin (1690), and sixteen years earlier than Captain Savery's patent (1698) for a pumping engine for raising water from mines.*

But to return to Old Square, at the date of the eventful evening in Thurloe's chambers. Morland was not a very young man; he had been resident for ten years at Cambridge, and had since then been to the Vaudois valleys as "Commissioner Extraordinary" for the distribution of moneys collected by the Protector. He had also been sent on an embassy to the Queen of Sweden, in company with Whitelocke, who in his Journal calls him "a very civil man, and an excellent scholar." Such appointments show that Morland must have enjoyed the confidence of Cromwell, and they render the theatrical story of the attempt to stab him improbable, but one can hardly doubt that the sudden flight and cordial reception at Breda were the result of some breach of confidence probably dishonourable to Morland.

The many secret matters which were discussed in Thurloe's chambers are evidenced by the State papers which were so anxiously hidden when the return of Charles was imminent. More than one writer on the haunts of Old London has confused the rooms where the Thurloe papers were found with the ground-floor rooms at No. 24, over which the Society of Arts have erected a memorial tablet, which were the rooms occupied by Thurloe during his active official life. The chambers in which the papers were found have now been pulled down. They were near to the west end of Lincoln's Inn Chapel, and looked out into a partly enclosed court known as Dial Court. Into these rooms, which were on the second and third floors, Secretary Thurloe moved during Richard Cromwell's short protectorate—shortly after he had ceased to hold office—and in these rooms he died, on the 21st day of February 1668. According to Mr. Thomas Birch's introduction to the Thurloe papers :—

> The principal part of this collection consists of a series of papers discovered in the reign of King William in a false ceiling in the garrets belonging to Secretary Thurloe's chambers, No. XIII., near the chapel in Lincoln's Inn, by a clergyman, who had borrowed those chambers during the Long Vacation of his friend Mr. Tomlinson, the owner of them. This clergyman soon after disposed of the papers to John, Lord Somers, then Lord High Chancellor of England, who caused them to be bound up in sixty-seven volumes in folio.—Preface to the "Thurloe State Papers," 7 vols., fol. 1742.

OLD MAP OF LINCOLN'S INN IN 1805.



Strange to say, there are Benchers of Lincoln's Inn who desire to pull down the old gateway and to sweep away these interesting old chambers that have played so important a part in English history. Some of them did not hesitate to insinuate that there was a doubt as to the identity of Thurloe's chambers, and that probably, if the matter were looked into, it would be found to be like most other antiquarians' stories, fudged up on very insufficient evidence.

Some years ago, when urging the Society of Arts to put up a tablet over Thurloe's Chambers, which they have since done, I examined the records of the Inn, and fully satisfied myself as to the identity of the ground-floor chambers at No. 24 with those occupied by Thurloe. The evidence of identity is derived from the old Red Books of

* Sir Samuel Morland was also the inventor of the speaking-trumpet and a calculating machine.

Lincoln's Inn, which contain minutes of the meetings of the Benchers, and notes of the fines paid to the Inn on the transfer of life interests in the sets of chambers belonging to the Inn. In the first volume, at p. 218, as part of the business transacted at a Council held on the 6th day of November 1646, is the entry—

Upon the peticon of Mr. John Thurlowe one of the Gent. of this house to be admitted into the chamber late belonginge to Mr. Robert Benson the elder and Mr. Robert Benson the younger. It is ordered hee be admitted paying to the Treasurer to the use of the house 25^{li} provided if hee be removed by order of this house hee shall have his money restored.

On the 22nd November 1659 there is an entry that—

upon the desire of John Thurlow one of the Masters of the Bench—It is ordered that Mr. John Doddington one of the Fellowes of this Societie shall have and be admitted into that ground chamber which he the said Mr. Thurlow now holdeth in Gate house Court in Chancery Lane-Rowe. He paying for the same to the use of the house Tenne poundes.

Mr. John Doddington held the ground-floor chambers vacated by Thurloe for six years, and was succeeded by Mr. Serjeant Coward, who held them for twenty-eight years, and disposed of them to Mr. John Hall in February 1693, who held the chambers till February 1722, when he was succeeded by Mr. John Chimmow. On the 28th of November 1734, Mr. Theodore Johnson was on the payment of £140 to the Inn admitted to

One whole ground chamber No. 24, in Gatehouse Court and Chancery Lane Row, late of Mr. John "Chimmow deceased."

Numbers are not generally used in the books of the Inn to denote the different staircases till after 1730; the first entry with a number I have found in the Red Books is in 1715. It is the admittance of a Mr. Hungerford to "Two chambers in Gatehouse Court and Chancery Lane Row number (1)." This was evidently, as at present, the stairway on the north side of the gateway. In 1720 there is an entry with respect to No. 26, which evidently refers to the stairway on the south side of the gateway, so that the numbers must have run as at present, and as in the old map of 1805, which has been procured for me by Mr. Milliken. The map will be interesting to those who can remember Lincoln's Inn as it was before the old buildings were pulled down and before the modern carriage way was opened into Lincoln's Inn Fields and Searle Street. The foundation-stone for the new hall and library in Lincoln's Inn garden was laid by Sir J. Knight Bruce, the then treasurer, in April 1843. Previously to that date the library of the Inn was stored in a large room at No. 2, Stone Buildings.

The usually accurate Cunningham says, in his *Handbook for London*, that the houses in London were first numbered in June 1764, and that "the numbering commenced in New Burlington Street. Lincoln's Inn Fields was the second place numbered." But though numbers do not appear in the books of Lincoln's Inn before 1715, the marking of the stairways by numbers—at all events, of some of the Inns—must have begun previously; for Edward Hatton, in his *New View of London*, published in 1708, says, in speaking of Prescott Street, Goodman's Fields, that "instead of signs the houses here are distinguished by numbers, as the staircases in the Inns of Court and Chancery." In the copy of Hatton in the Reference Library in the British Museum there is a MS. note in the margin, in an old hand, stating that these were the "first numbered houses."

The numbering of the Temple had begun in 1712. I have a series of letters to Serjeant Pengelly (afterwards Baron Pengelly), in whose house Richard Cromwell died. The first letter in which a number is made use of is dated 22nd of May 1712. It is addressed--

For Mr. Sergant Pengelly at his chambers in the Inner Temple, Tanfield Court, Nr. (3). London. These—

A little picture of the number is drawn, with a circle round it, as if it were a picture of a sign. The numbering of London streets did not become general till after 1762, when London signboards began to be done away with under the powers given by 2 Geo. III., c. 21. Before that date the houses without signs were frequently described by reference to other houses with signs; thus an address would run—to Mr. *So-and-So*, at his house, over against the three balls, in *such and such* a street.

During the last twenty years one block of Lincoln's Inn Chambers after another has been pulled down to be replaced by large red brick blocks of chambers, built at the expense of the Inn, at first under the superintendence of Sir Gilbert Scott, and latterly under the superintendence of Lord Grimthorpe, who has acted as volunteer and Honorary Architect of the Inn. I readily acknowledge that some of the changes made have been real improvements, and that the buildings which have been erected under the superintendence of Lord Grimthorpe are in many ways more substantial and more convenient than those planned by Sir Gilbert Scott. Up to 1885 the stairways numbered 2 to 15 of Old Buildings had been cleared away, and it was part of the Benchers' plan, or of Lord Grimthorpe's plan, to continue the work as the Inn could afford it, "improving" away the gateway and the corner of Old Square, sacred to the Long Parliament men.

In 1885, when the gateway was reached, a numerously signed petition was presented to the Benchers praying them "to countermand the further destruction of the buildings of the Gatehouse Court, on account of the historic interest which attaches to them, as well as on account of their picturesque appearance and fire-resisting* structure." This petition was numerously signed by members of the Inn, and was formally signed by the President of the Society of Antiquaries in pursuance of a vote of the Society, as well as by the President of the Society for the Protection of Ancient Buildings. In acknowledging the receipt of the petition, which I had the honour of sending in for the petitioners, Lord Justice Cotton, as Treasurer of the Inn, wrote to me on the 19th of March 1886, saying that he was requested by the Masters of the Bench to acknowledge the receipt of the petition, and added—

I thank you for the trouble you have taken, to obtain so wide an expression of opinion for the assistance of the Bench, and have to inform you, that there is no present intention of proceeding with the demolition of the Buildings in Gate House Court, and that the representations of the Petitioners shall have full consideration, should occasion arise.

This, together with the inscription which the Society of Arts had affixed, with the leave of the Bench, over the Chancery Lane windows of Thurloe's rooms was, I thought, sufficient guarantee that the work of destruction would not proceed further. But where money is to be spent in bricks and mortar, there are many natural influences which work against the preservation of old buildings. I will not deal with surmises, but will state facts patent to everyone.

* This was in reference to a statement in the petition that there had been no destructive fires in Old Buildings, the timbers of which are of oak, while seven of the more recent deal-timbered buildings of New Square had been completely gutted in a shorter period.

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Since the date of the Petition the outside wood and iron work of the old buildings have not been painted, but have been allowed to grow disgracefully dirty, so that fresh tenants will not move into them as the old ones leave,* and those interested in sweeping away the memories of the past began to speak of the old chambers as a disgrace to the Inn.

Fortunately the rebuilding was a costly affair, and could not for a moment be defended from an investment point of view. Opinion had been so strongly expressed against the destruction that the destroyer had to stay his hand, and for three or four years there was a lull in the battle; but last year the Inn had a sudden accession of riches. The Bench, as is well known, sold the ground rent of Furnival's Inn for £100,000, and with this to work upon the agitation was immediately revived. Architects were called in to report on the stability and condition of buildings which, it should be noted, had stood firmly and safely enough for three hundred years, and they did *not* recommend that there should be no rebuilding. The architects pointed out that additions and alterations had been made since the date of the original building, as indeed is the case with all interesting old buildings which have been in active use and have developed with the times.

Our plate, for example, shows every variety of date of window, from the original windows with stone mullions in the tower over Thurloe's door-way, to the later Jacobean windows with small lead casements at No. 25. The early Dutch sash windows of the reign of William and Mary, and the later round-topped and flat-topped sash windows, with wood-work flush with the wall, of the first half of last century—the latter of these put in before the Fire Act of 1774 (12 Geo. III., c. 78), which prohibits wooden projections and ordains that all windows are to be set back in Reveals (sec. 46) at least four inches from the front of the building. The front of the great gateway shows the greater part of the bricks as originally laid with black bricks in lozenge-pattern, and places where alterations have been made when the British Bond and Flemish Bond or method of laying bricks were in use. The bricks of the top courses and of the parapet at the top of the gateway are of the modern size, evidently made since the Brick Act of 1784 (24 Geo. III., c. 24), which put a duty of 2s. 6d. per thousand on all bricks, and heavier rates on certain sorts of tiles or bricks—an act which had the indirect effect of increasing the dimensions of the bricks generally in use to the full size that could conveniently be used, or perhaps that was allowed to pass at 2s. 6d. per thousand. Such marks of time should not be talked of as defects, but will be ranked by the intelligent legal eye as greatly adding to the interest of an old building.

In addition to the investigations which the architects were called in to make, some one has been allowed, whether with the direct permission of the Benchers or not, I do not know, within the last year to strip the rooms of the northern tower of the gateway of their oak panelling made before the invention of the rebate plane, and to remove, as it seems to me very improperly, some of the supports of the timbers over windows. It was no doubt done professedly to trace the course of a few old settlement cracks, the dust within which shows that there has been no progressive settlement of the building in recent times, and to expose certain parts of the inside brickwork which had been cut away to make cupboards and for other purposes. It is now asserted that the building is "beginning to go," and is in a dangerous condition, and during the last fortnight it has been tied up with iron rods passing through the rooms to a wooden framework on the outside, which gives the building a most decrepid appearance.

There can be no doubt that a clever engineer can tie up and make any building secure without disfiguring it; and the obvious duty of the Benchers now is to give instructions, either to their able amateur architect and adviser, who has spent so much of his own money in restoring and preserving St. Alban's Abbey, or to some professional architect, that these historical old buildings must be reverently maintained. I will not employ the term "restored," for it has been used as a cover for so much Vandalism. If necessary the walls might be thickened where they have been interfered with.

The facts only require to be widely known to make it impossible for those who have so little reverence for the past to proceed with the destruction of these buildings which can never be replaced.

* This is perhaps natural from another point of view, for tenants will not move into chambers where they think that they are likely soon to be disturbed.

Notices of Books.

Modern Views of Electricity. By Prof. Oliver J. Lodge, D.Sc., LL.D., &c. &c. (Macmillan & Co. 1889.) Prof. Lodge's book is not an easy one to read, though he has made great efforts to write lucidly on a very difficult subject. It is perhaps not always where he makes the greatest effort at simple explanation that he is most successful; but the labour of reading and re-reading some passages in order to grasp their meaning will be amply rewarded by a rich harvest of fresh thoughts. The book especially appeals to those who already have some little knowledge of elementary physics. It is in no sense a practical treatise, but by a series of clever mechanical analogies it tends to open the eyes and to cultivate the power of rationally imagining how the natural phenomena with which we are familiar *may* be produced. In a word, it attempts to give an insight into Nature by the light of our present knowledge derived from ponderable matter, and to explain the properties of ether by complicated mechanical contrivances which we know can have no actual existence in Nature. Of the value of the method adopted we quote, with sincere approval, the author's words: "There are no minds, I believe, to whom some mental picture of the actual processes would not be a help if it were safely available."

The final object of natural science is thus to realise nature, and to understand, that is to trace, cause and effect in her phenomena, and by images built up of parts with which we are familiar to account for the connection between the phenomena we classify as causes and those we classify as effects.

The first chapter of Prof. Lodge's book contains an exposition of Fundamental Notions. It should be carefully mastered, because the whole of the subsequent contents are based on the idea that electricity is a substance. The considerations are raised in forcible manner; assume that it is impossible to remove the air from an enclosed space, how would the existence of air be recognised? The answer is in four ways: in each and all of these, and in no other way, have we become cognizant of the existence of electricity. We next learn that electricity is incompressible, and the phenomena of electrical charge and induction are illustrated by the phenomena which would be exhibited on pumping an incompressible fluid from one elastic bag to another. An ingenious hydraulic model of

The Gateway of Old Square, Lincoln's Inn, which the Benchers of the Society propose to pull down.

In the corner at No. 24 is the entrance to the chambers of the Secretary of State and trusted friend of Oliver Cromwell, Mr. John Thurloe. They were occupied by him during the whole period of his active political life, and much important business of the Commonwealth is known to have been transacted in them.

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a Leyden jar is given in illustration of the oscillatory character of its discharge.

In Part II. Conduction is dealt with, and the difficult problem of conceiving of what a current of electricity consists is considered. The exposition of the nature of the real contact force is particularly suggestive, and the improvement on the old view is very manifest. In connection with electrolytic conduction we are brought face to face with the mysterious and definite charge of a monad atom, and the solution of the abstruse questions as to the nature of chemical affinity. On page 86 it is said that atoms which have had their definite charges wrenched off, escape, and are "glad to combine." Why? They have just lost that definite charge which, on the previous page, is given as the cause of their hanging together; instead of being in a condition of maximum chemical activity these atoms should be chemically inert. The same question arises after reading Faraday's original papers. Again, why, if the electrical theory is alone to be relied on, do two isolated hydrogen (or oxygen) atoms combine to form a molecule of hydrogen (or of oxygen) with the evolution of considerable energy, when both atoms have like electrical charges? This part of the book tends to stimulate further inquiry. The last section of this part, by consideration of the moving charge with its accompanying strains, introduces the idea of rotatory motion of the medium wherein magnetism is held to consist. The experimental basis of that idea is very clearly exhibited in well illustrated experiments.

The last part of the book is the most interesting of all. The relation between the electrical disturbance of a medium and of light, and the conclusion that light is an electrical disturbance, and that light waves are excited by electrical oscillations, is shown in all its far-reaching theoretical and practical import. In connection with the question of the manufacture of Light, the extravagance of the present mode of producing light by an incandescent carbon filament, and the theoretical absurdity of burning gas or oil, is exposed in an impressive manner. To take the former only; we pass energy into a carbon filament, but only a very small percentage is obtained in the form of light. Light begins to be emitted only when the particles are vibrating with sufficient rapidity; but before that point is reached, and after it has been reached, a whole thronging crowd of slower vibrations are set up which, for the purpose in view, are useless. It is as though, in order to sound some little shrill octave of pipes in an organ, we were obliged to depress every key and every pedal, and to blow a hurricane. The secret of the glow-worm has yet to be learnt: when that has been discovered the problem of lighting will be solved.

"Conclusion," writes the author, "is an absurd word to write at the present time, when the whole subject is astir with life, and when every month seems to bring out some fresh aspect, to develop more clearly some already glimpsed truth." The justification of this statement is then established in an almost dramatic manner: for the reader is introduced to the brilliant researches of the young German physicist Hertz, on the transmission of electrical oscillations. Hertz, in a manner and with a neatness worthy of Faraday, established the fact that electric waves obey the same laws as those of light, in transmission, in reflection, and in refraction. Clerk Maxwell's speculation can now no longer be the subject of sincere and rational doubt. Would that he were alive, and could rejoice in the experimental proof of the connection which his intuition predicted. His memorial remains, and his fame will daily grow greater.

Our object will be fulfilled if this review excites interest in a book which everyone who wishes to obtain an insight into the scientific thought of the present day should read.—A. C. R. and W. C.

Monograph of the British Cicadæ. By GEORGE BOWDLER BUCKTON, F.R.S. Parts I. and II. (Macmillan & Co.) As a group of insects, the British Cicadæ, notwithstanding the extraordinary abundance of some of them, are probably almost entirely unknown to the general public, and in consequence they have no generally received popular name. Some few are called "frog-hoppers," "spittle-blight," and "grass-flies," but we have only one representative of the "singing" Cicadæ, and that a rare one, and of the rest, no more than a single species is at all likely to have ever obtruded itself upon the notice of the casual observer. This is the common garden pest, which, by distilling from the sap it feeds upon, the frothy mass called "cuckoo-spit," too often disfigures and damages our plants and shrubs. Nor indeed to the bulk of entomologists have they, until quite recently, been much better known. This was, no doubt, mainly due to the lack of information on the subject in English scientific literature. For nearly twenty years, all that English entomologists had to guide them was the Rev. T. A. Marshall's "Essay on the British Homoptera," published in the *Entomologists' Monthly Magazine* for 1867, and a few scattered notices by Scott, Edwards, and others, in subsequent volumes of the same publication. In 1886 and 1888, however, Mr. James Edwards contributed to the *Transactions of the Entomological Society* a valuable and accurate "Synopsis" of the group. This was a great advance; but the scope of Mr. Edwards' work, which was mainly that of specific determination, necessarily left many questions of great interest untouched, and the way was still open for an exhaustive monograph, which should put, for the present, the finishing stroke to the English literature of the group; this is the work which Mr. Buckton has set himself. On the completion of the eight parts of the present monograph, the first two of which are now before us, English entomologists will have ready to hand, not merely descriptions, but also enlarged and coloured figures of all the British Cicadaria, together with observations on their occurrence and distribution, and discussions of interesting points connected with their habits and general natural history. There will then be no longer any excuse for the neglect in which this very singular, though by no means extensive, group of insects has hitherto been left. The four hundred coloured illustrations promised will enable each species to be, as a rule, represented by several figures, which, taken from specimens in the cabinets of the recognised English authorities, should prove useful aids in the determination of species, a matter more than usually difficult in this group. The illustrations are drawn and lithographed by the author himself, in the style with which he has made entomologists familiar by his beautiful delineations of the Aphides in the volumes published by the Ray Society. Thus Mr. Buckton's work will serve to supplement rather than to displace that of Mr. Edwards, which may still be profitably consulted for specific determination.

The British Cicadaria number only some 230 species, and are therefore a very manageable group for those who have not sufficient leisure to undertake a whole order, and as the life histories of many are still practically unknown, and the number of workers is still deplorably small, there is plenty of scope for the energies and enthusiasm of zealous students. There is no dearth of material, for the insects swarm on all hands, in meadows, hedgerows, copses, and marshes. We cordially welcome, therefore, this further contribution to the natural history of the

British Cicadaria. The labour involved in the preparation of such a work is extremely great, and deserves to be highly appreciated; and we trust that the splendid illustrations and the discursive paragraphs on habits, economy, &c., which are the most novel features of Mr. Buckton's work, will be the means of drawing more attention to this neglected group, and of largely recruiting the ranks of the small band of English Homopterists. In the first part we notice a few orthographical peculiarities, such as the duplicate spellings "pygophore" and "pygofer," "brachycranus" and "brachicranus," which are rather confusing. In the localities given for *Garyara genistæ*, Chobham, *Kent*, should, of course, be Chobham, *Surrey*; but for this slip Mr. Buckton is not responsible.

Travels on the Amazon and Rio Negro. By Alfred Russel Wallace, LL.D. (Ward, Lock and Co.'s Minerva Library of Famous Books.) The publishers have shown sound judgment in selecting this as one of the "famous books" for their excellent "Minerva Library." The expedition whose incidents are so unpretentiously related in this volume, formed one of the earliest chapters in the history of the theory of Natural Selection. It was the first of its kind which Mr. Wallace undertook in search of facts "towards solving," as he himself expressed it at the time, "the problem of the origin of species"; and during the four years it lasted he visited many parts never trodden before by Europeans, amassed large collections of animals and plants, and by his untiring energy and zeal and his wonderful faculty of observation, accumulated a great assemblage of facts bearing on the relations between animals and their environments. This journey has therefore an abiding interest as a factor in the progress of scientific thought, and its simple and unostentatious record has, in consequence, a special attraction for all who care to trace the history of great discoveries, such as that which has of late years so utterly revolutionised biological science. But apart from its special scientific interest, the *Travels on the Amazon* is the sort of book every intelligent reader might be glad to possess; open it where you will, you are sure to come across something worth reading. The scene of the traveller's wanderings is the virgin forest, the land of the jaguar, boa constrictor, and alligator; it is here that he makes his first acquaintance with strange creatures like the sombre umbrella-bird, with its oddly constructed hood and danglet of feathers, and the bulky manatee that haunts the streams and browses on the river-side vegetation. He gazes with delight on the brilliant blue Morphos, the grandest of all butterflies, as they bask in the sunshine, and upon the gigantic *Victoria regia* water-lily, as it floats on the remotest pools; and yet, notwithstanding the grandeur and luxuriance of so much of the tropical vegetation, and the elegance or quaintness of the animal life that is often so abundant, he is fain to confess that there is a soft charm and a pleasing beauty about the scenery of Old England which these wild regions lack, and, by reason of lacking it, fail to make so pleasant an impression on the mind. There is a pathetic interest attaching to the explorer's return from his long expatriation. Some parts of his collections had been sent home from time to time to be ultimately disposed of to defray his expenses; but the greater part of them, together with the notes and sketches made during the last two years, he was bringing home with him in a trading-vessel when the ship took fire and was utterly destroyed, the whole of the collections, notes and drawings sharing the same fate. After ten days of considerable suffering and privation in an open boat, the unfortunate travellers were picked up by a homeward-bound vessel and ultimately landed at Deal. The tale of this calamity is very touchingly told by the author. A brief biographical sketch by the editor, Mr. G. T. Bettany, gives an outline of Mr. Wallace's life and chief contributions to science, and the publishers have added a map of the district and some neat views of Amazonian scenery. It only remains to add that the paper is good and the binding neat and substantial, making a thoroughly useful book. As the work is so full of detail, a carefully arranged index would have been a useful addition.

Old Friends; Essays in Epistolary Parody. By Andrew Lang. (Longmans & Co., 1890.) The readers, in other words the possessors, of *Letters to Dead Authors* will welcome this book and give it a place beside their favourite. It was a happy idea of Mr. Lang's, after addressing the immortals in language which is a reflex of their own, to invent a correspondence between the characters by whom that immortality is secured, and who are thus brought into personal relations of which their creators could not dream. The letters between Harold Skimpole, Esq., and the Rev. Charles Honeyman, M.A., both of whom hail from a sponging-house, are perhaps the wittiest of the series, although Mrs. Gamp's views on modern nurses, addressed to her friend Mrs. Prig, run them hard. But most felicitous of all is the group of letters between some familiar characters in the novels of George Eliot and Miss Broughton. Altogether, the book is born of a bright idea brightly carried out.—E. Clodd.

Rambles in the Black Forest. By H. W. Wolff. (Longmans & Co., 1890.) These "rambles" have all the charm of a picturesque and vivid book of travel with the completeness of a guide-book, the one thing lacking being a map in which the walking-routes are clearly marked. Mr. Wolff first set foot in the Forest nine-and-twenty years ago, and although railways have been built and highways made since then, it remains the paradise of pedestrians, where a man may "walk from end to end, ninety miles one way and over forty another, climbing over mountain-tops or keeping in the valleys," measuring exercise according to taste, and always sure of finding clean quarters and decent food, and all amid scenery of richly-varied, continuous beauty. The book is delightfully written, and with the practical information given concerning the industries of the district and the domestic life of the peasantry the author has skilfully blended descriptions of their quaint customs and outlines of their legends which have survived, as immaterial things so often survive, the destruction of man's handiworks by man's ruthlessness.

Tales of the Sun; or Folk-Lore of Southern India. Collected by Mrs. Howard Kingscote and Pandit Natêsá Sástrî. (W. H. Allen & Co., 1890.) Thanks mainly to the labours of the Folk-Lore Society, the interest in folk-tales, as holding within them the key to certain problems, such as the origin and migration of races among whom the tales and legends are found, grows apace. India, which in the judgment of some scholars is their native home, has certainly yielded abundant harvests to the collector's sickle. Temple's *Wide Awake Stories*, Lehari Day's *Folk-Tales of Bengal*, Stokes's *Indian Fairy Tales*, and Frere's *Old Deccan Days*, are a few out of the many which the East has given for the delight of childhood in the West, and the volume before us is a worthy and welcome addition to the stock. Its contents, albeit the titles of many of the tales have a copy-book moral heading which has an exotic look, will hold the children spellbound, and prove of value to the comparative folk-lorist, who, when his analytical processes are over, cannot do better than restore the prettily got-up volume to its more rightful place upon the nursery shelf.—E.C.

TRACES OF GILLS IN THE THROAT OF MAN.

MR. BLAND SUTTON, who is well known as a careful and original worker, has sent us a well illustrated volume, entitled *Evolution and Disease*,* which is a model of popular science writing. He uses only such technical terms as are absolutely necessary in introducing the public to some of the most interesting problems of the physiologist, throwing many new lights on diseased forms of growth, and malformations, which have hitherto been too frequently looked upon as mere fortuitous accidents. Mr. Bland Sutton has a quick eye for connecting diseased forms and malformations with facts in the history of the embryo and of the species. He reads in a hairy tumour or malformed limb eloquent evidence as to the biological history of the individual or its ancestors. According to Mr. Sutton, there seems to be no such thing as a freak of Nature; every form, however abnormal, may be accounted for and made to yield evidence with respect to the evolution of the individual in which it occurs.

It is well known that many parts are present in the embryo which are not represented in the mature animal and that when parts are precociously developed in the embryo and but feebly developed in the adult it indicates that they were of high importance to the early ancestors of the animal. Embryology furnishes abundant evidence supporting the view that the ancestors of existing vertebrata were aquatic in their habits, that respiration was carried on in them by means of gills, and that many structural peculiarities in mammals result from the transformation of an aquatic into a terrestrial animal, Mr. Bland Sutton says that the type of respiratory organs in these ancestral forms is to be seen in such fish as the dog-fish and the lamprey. Water, charged with air, enters the mouth and is forced through openings in the walls of the pharynx. The pharyngeal orifices, or branchial slits, are furnished with vascular processes known as gills. In the gills, or branchiæ, the blood and water are merely separated from each other by an extremely delicate layer of tissue. Hence venous blood circulating in the gills readily gives up the excess of carbon dioxide, and as readily obtains oxygen from the surrounding water. The gills of fish and batrachians are supported upon a cartilaginous or bony framework known as the branchial bars; and in such fish as sharks a small cutaneous fold projects from each bar and covers the gill-slit as with a lid. These cutaneous lids are named, in consequence, opercula. The gill-slits with the opercula are shown in Fig. 1 as they are seen in a young dog-fish.

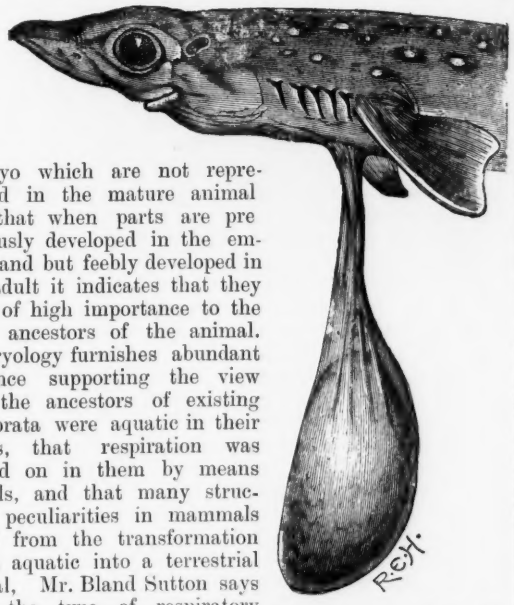

Fig. 1.—Gill-slits of Recently Hatched Dog-Fish with Yolk-Sac.

(The cuts have been kindly lent for the illustration of our review by Mr. Walter Scott.)

The first slit bears no gills in the adult fish, and is known as the spiracle or blow-hole. In the embryo it is furnished with beautiful external delicate vascular tufts.

The neck of a mammalian embryo is furnished with four similar slit-like orifices, communicating with the pharynx as in the dog-fish, and though they never support gills they are furnished with a small swelling or tubercle, representing the operculum. In the human embryo four branchial slits present themselves. The first of these represents the spiracle of the shark, and becomes the tympano-eustachian passage subservient to the sense of hearing. The small tubercles surmounting it coalesce, and gradually give rise to the pinna or external ear. In cases of normal development the posterior gill-slits disappear; but it is by no means uncommon to find in the sides of the neck of a child, along the anterior border of the sterno-mastoid muscle, small openings in the skin capable of admitting a thin probe. These congenital fistulæ, especially when they exist in the upper part of the neck, communicate with the pharynx. This in some cases may be demonstrated by allowing the child to swallow milk, when drops of the milk will find their way through the fistula and appear in the neck. The usual situations of the four branchial slits are indicated in Fig. 2.

Fig. 2.—Side View of the Neck.—The Figs. I., II., and IV. indicate the common situations of branchial fistulæ.

Sometimes we find in the situations frequented by these fistulæ, instead of openings, small rounded white patches of skin, natural cicatrices, indicating the points of obliteration of the clefts. It is by no means infrequent to find the cutaneous orifice of a persistent branchial slit surmounted by a cutaneous tag, which often contains a small nodule of yellow elastic cartilage resembling that found in the pinna. These projecting pieces of skin often occur unassociated with fistulæ, and are most common in two situations in the neck at the spots marked III. and IV. As a rule they are symmetrical; usually they are short, often looking like mere pimples on the side of the neck. In some cases they attain a length of two or three centimetres. A very large one is represented in Fig. 3 as it grew from the side of a girl's neck. These fistulæ and cervical auricles, or ears, as they are called, usually affect many members of a family. The mother may possess

* *Evolution and Disease.* By J. Bland Sutton. (Walter Scott, London 1890.)

cervical auricles, and one child have a cervical fistula, whilst a third may have fistulæ and auricles combined.

Pendulous tags of skin or auricles are frequently found on the necks of other mammals — such as pigs, sheep, and goats. In some species of goats they are a very marked feature, and are nearly always present.

Fig. 3.—A Girl with a Cervical Ear, or Auricle.

One result, says Mr. Sutton, of the transformation of aquatic into land animals produces greater inconvenience than can be attributed to cervical auricles. In many situations where canals open on a free surface, the terminal orifice of the canal is, as a rule, surrounded with glands and a collection of tissue, peculiar in structure, termed adenoid. Such glandular collections are more abundant around the terminations of functionless ducts.

Some of the more characteristic examples occur in the pharynx, marking the inner orifices of the branchial clefts. Of these the most conspicuous is named the tonsil. The tonsils are familiar to everyone as the sub-globular shaped structures lodged in the recesses on each side of the mouth, at the spot where the mouth joins the pharynx, or cavity, where the nasal and buccal passages become directly continuous.

Fig. 4.—An Egyptian Goat (*Hircus thebaicus*) with Cervical Auricles.

The tonsils vary considerably in size—in some persons they are large and prominent, in others small, and scarcely recognisable. The niche in which each tonsil is lodged is termed the tonsillar recess, and indicates the exact spot where the second branchial cleft in the embryo communicated with the pharynx; it is also the spot where the cleft, when persistent, opens internally. How far the tonsils subserve any useful purpose is very doubtful; certainly they are often removed, and persons usually experience relief rather than suffer inconvenience from the loss. It is quite certain that the tonsils are often the seat of disease which is not merely troublesome to the individual, but is at times fraught with great danger to life.

Mr. Bland Sutton's chapter on the enlargement of parts from increased use and irritation is very interesting, as well as that on disuse and its effects, and the transmission of malformations or acquired defects. We confidently recommend the book to our readers.—A. C. R.

A SIMPLE EXPLANATION OF CLERK MAXWELL'S THEORY OF ELECTRICITY.

By R. Camper Day, B.A., Oxon.

I.

In Professor Lodge's interesting book on *Modern Views of Electricity*, an attempt is made to show how the various effects of electricity can be illustrated by means of mechanical models. There is a hydrostatic model to illustrate the Leyden jar, a system of cords, beads, and elastic strings to illustrate static electricity, and a system of wheels and racks to illustrate magnetism and current electricity. Such models are of great value in assisting the student to a mental vision of electrical forces. They are not intended as an explanation of those forces, but merely as an aid to the memory or the imagination. It is perhaps unfortunate that the working models illustrating static and current electricity should be so very dissimilar; for static and current electricity are undoubtedly one and the same thing, and the student naturally endeavours to combine the two models in his mind, and finds a difficulty in doing so.

Those who have experienced this difficulty will perhaps be interested to read a popular account of the remarkable series of papers, published in the *Philosophical Magazine* in 1861, in which the late Professor Clerk Maxwell endeavoured to explain what kind of thing electricity must be, or, in other words, the probable nature of the mechanism by which electric or magnetic influence is transmitted through air or any other medium. His arguments are very abstruse, and depend almost entirely on problems in higher mathematics. It is not proposed to follow them in this paper, but merely to give an elementary and pictorial outline of the mechanism which he suggests.*

As a preliminary it will be necessary to recapitulate, as briefly as possible, some of the facts which the theory is to explain. We know that a magnet exerts a force upon another magnet varying inversely as the square of the distance, and that a similar force is exerted by one charge of static electricity upon another. We know that a current of electricity in a wire influences a magnet suspended near it; if we picture to ourselves a right-handed screw advancing along the wire with the current, then the north pole of the magnet will be deflected in the direction in which the thread of the screw rotates. If we have two parallel wires carrying currents in the same direction they attract one another; if they carry currents in opposite directions they repel one another. If a current be suddenly started in one wire, there is a momentary reversed

* A fuller account will be found in the *Life of James Clerk Maxwell*, by Lewis Campbell and W. Garnett, in Dr. Fleming's recent work on the Alternate Current Transformer, or, better still, in Maxwell's own papers.

current in the other; and if a current is suddenly stopped in one wire, there is a momentary (but not reversed) current in the other. If there be a steady current in the one, and the other be made to approach or recede, a current (in the opposite or the same direction) appears in the latter during its approach or recession. When the current in a coil of wire is broken there appears what Faraday called the "extra current," which may be emphasised by increasing the number of coils or by inserting an iron core. These are some of the facts which have to be explained by any comprehensive theory of the nature of electricity.

Some people have thought that a magnet or an electric charge produces its effect by means of "action at a distance," that is, that the force is not communicated step by step through the intervening medium. This view presents many difficulties: for example, as Faraday pointed out, the curvature of magnetic lines of force, and the fact that different effects are produced when different dielectrics are interposed between two charges of electricity. According to Maxwell's hypothesis the electric influence is transmitted step by step through an intervening medium, and this is the same medium which is supposed to transmit light, the luminiferous ether. But light is propagated by undulations, and undulations, as Maxwell points out, will not account for magnetic lines of force, because two series of undulations traversing the same space will not combine into one resultant, as two attractions do. He therefore supposes electricity to be transmitted by the same medium as light, but in a totally different manner.

What kind of structure, then, are we to imagine for this luminiferous ether, such as will enable it to perform the diverse operations above referred to? We know, to start with, that the ether possesses the power of transmitting motion (waves of light) with a definite velocity; we know that it can be set in motion; and we know that it possesses density, very slight, perhaps, but real. In other words it has what in mechanics are termed "mass" and "elasticity." These are known facts, starting from which we will proceed to build up our hypothesis of the structure of the ether.

Let us suppose that the medium, which fills all space whether containing matter or otherwise, consists of a vast number of minute elastic spherical bodies closely packed together. These bodies we will call "vortices." We will imagine them capable of being rotated on any axis with extreme velocity. Now when an elastic sphere is rotated on an axis it tends to become an oblate spheroid; its equatorial diameter enlarges and its polar diameter contracts. If, therefore, we suppose that in a small region of space all the vortices are rotating, and that all their axes are pointing in the same direction, it is evident that the pressure will not be equal in all directions. It will be least along the lines in which the axes of the vortices lie, and greatest at right angles to these lines. There will be a "tension" along the axes of the vortices, and a "pressure" at their equators.

The familiar experiment of iron filings sprinkled on a piece of paper laid over a magnet will help us a step further. It is well known that the filings will set themselves in lines, usually called "lines of force." If a north pole of one magnet be placed near the south pole of another, the lines of force will run from the one to the other. Let us suppose that along each line of force there is a row or chain of vortices, and that they are all rotating round the line of force as an axis, like a row of beads threaded on a string. There will then be a tension along the line of force and a pressure at right angles to it. Consequently each line of force will tend to shorten itself and to repel the neighbouring lines; but this is just what magnetic lines of force do, as may be shown by experiment, and further, the attraction and repulsion of magnetic poles is exactly such as would result, according to Maxwell's calculations, from a field of vortices rotating in the manner described.

This field must now be considered more in detail. It is neccessary to suppose that, in a given portion of it, all the vortices are not only rotating, but rotating in the same direction. If we look along a line of force from a north

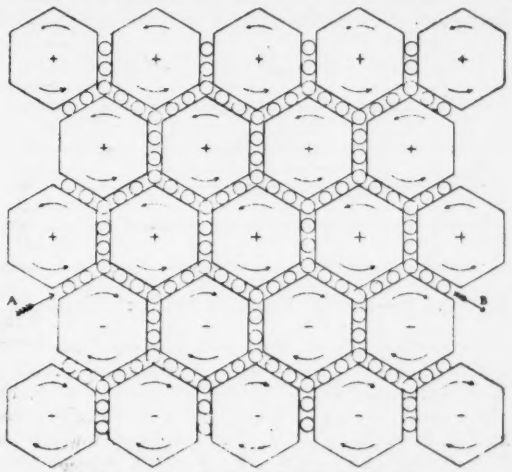

FIG. 1.—A FIELD OF ETHER VORTICES

magnetic pole towards a south pole we shall see the vortices rotating in the same direction as the hands of a watch. A moment's reflection will show that if they touch they will interfere with one another, because at every point of contact the circumference of each vortex is supposed to be moving in the opposite direction to that of the next. In order to overcome this difficulty we will suppose that the vortices are separated from one another by a single layer of minute round particles, that these particles are extremely small as compared with the vortices themselves, and that the particles do not touch one another. We have then some such field as is approximately represented in Fig. 1.

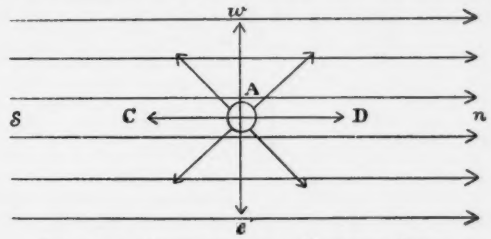

FIG. 2.—A NORTH POLE IN A MAGNETIC FIELD.

For the sake of convenience the vortices are here shown as hexagons instead of circles, and the round particles are much too large as compared with the vortices. It must be borne in mind that just as the vortices are extremely small when compared with molecules of matter, so the particles are extremely small when compared with the vortices. For the present we will look upon the particles as merely a contrivance to ensure that the vortices shall all rotate in in the same direction; it will be shown in the sequel that they have other important functions to fulfil and are in fact electricity.

But before we discuss electricity let us fix our ideas by considering some particular cases of magnetism. In

Fig. 2 let the parallel lines represent a field of terrestrial* magnetism, and let the arrow-heads always indicate the directions in which we must look to see the vortices rotating in the direction of the hands of a watch. We will call this kind of rotation right-handed and the reverse left-handed. The circle A is the north pole of a suspended magnet, from which the lines of force radiate as shown. On the north side of A the radiating lines of force tend to rotate the vortices in the same direction as do the lines of the field, and the velocity of rotation will therefore be increased. On the south side they tend to rotate the

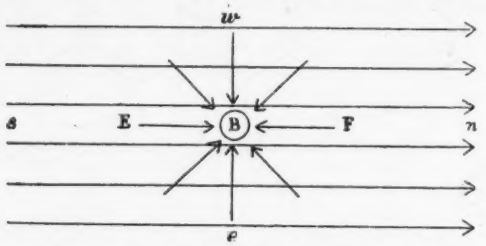

Fig. 3.—A South Pole in a Magnetic Field.

vortices in the opposite direction, and the velocity will therefore be reduced on that side. Consequently, there will be a greater tension in the lines of force north of A than in those south of A, and A will tend to move to the north.

In Fig. 3 we may suppose B to represent a south pole, and by similar reasoning it may be shown that the tension on the south side of B will be greater than on the north side, so that the pole will tend to move towards the south.

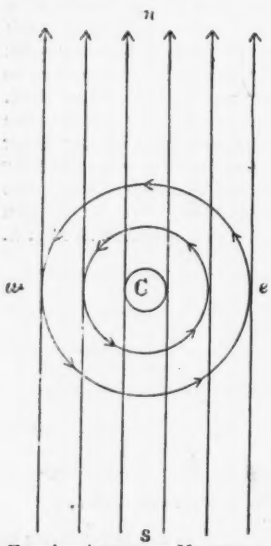

Fig. 4.—Action of Magnetic Field on a Current.

Let us now suppose that instead of a magnetic pole suspended in a magnetic field we have a wire conveying an electric current. Such a wire, as is well known, has lines of force about it similar to those of the magnet, but instead of radiating from the wire in all directions they surround it in rings. If then a wire conveying a current be suspended in a magnetic field and be free to move, what will happen to it? It will move, and a consideration of Fig. 4 will enable us to predict the direction. In this figure, C is the section of the wire conveying a current, which is supposed to be ascending through the plane of the paper, in a field of force. The arrow-heads, as before, indicate the direction of right-handed rotation. At *e* the lines of force caused by the current will tend to rotate the vortices in the same direction as they are moving in the magnetic field; at *w* they will tend to rotate them in the opposite direction; so that the resultant rotation will be more rapid on the east side than on the west. Both sets of vortices have their equators turned towards C, so that they tend to expand towards C, but those on the east side have the greatest effect; and therefore the resultant effect on the current is to urge it towards the *west*, a conclusion which may be easily verified by experiment.

(To be continued.)

* It must of course be borne in mind that the magnetic north pole of the earth corresponds to the south pole of an ordinary magnet.

Letters.

[The Editor does not hold himself responsible for the opinions or statements of correspondents.]

SOME PROPERTIES OF NUMBERS.

To the Editor of Knowledge.

Dear Sir,—In fulfilment of my promise to your readers, given in Knowledge of February, I beg to state, in conclusion, one or two facts about Circulating Decimals, which may prove interesting to many. If we divide 10, 100, 1000, 10000, &c., *i.e.* 10^p by any Prime Number greater than 5, we get a series of remainders which possess many peculiar properties.

(1) The *sum* of the remainders is always exactly divisible by the Prime Number.

Bring 1/41 to a Circulating Decimal, *i.e.* divide 10^p by 41, and we shall get the remainders 10, 18, 16, 37, 1. As these remainders always recur, we might go on dividing for ever, and we should never get any other, and they appear always in the same order. The sum of these remainders equals 82, which is exactly divisible by 41.

(2) The *product* of the remainders leaves always a remainder 1, when divided by the Prime, if the period be *odd*. If the period be *even*, and we add one to the product, then there will be *no remainder* when divided by the Prime. The reason of this is, that the product of *any two conjugate remainders* (if I may so call them) always leaves a remainder 1, when divided by the Prime Number. Thus, *e.g.* 10×37; 18×16; each give a remainder 1, when divided by 41, and the principle is universal, whatever prime we use and however many remainders there be. Let us take the case of 1/7. The figures of the decimal are 1, 4, 2, 8, 5, 7, and the remainders are 3, 2, 6, 4, 5, 1. Here we see 3×5; 2×4; each give a remainder 1 when divided by 7. But in the case of an even period, there is always a remainder which is one less than the Prime we are dividing by. In the above example we see that $7-1=6$. Hence the rule for even periods given above.

(3) Notice particularly the remainders just given, and the figures of the decimal. It is observable at once that we can get one from the other. Multiply the remainders by 7 and you have the decimal, and *vice versâ* by using a multiplier 3. Of course, in multiplying we keep the units' figures only.

This law is also general, and the multipliers are 1, 3, 7, or 9, according as the Prime Number Divisor ends in 9, 3, 7, or 1.

(4) Suppose we are going to turn 1/17 into a decimal. Can we tell where certain remainders will turn up? Yes; and we can get the remainders backwards or forwards *ad libitum*, and in many ways. If the remainder 2 turns up anywhere, we can at once fix the position of 5, for these two numbers seem to be inseparable companions. Suppose 2 is the eighth remainder of 1/23, then 5 is sure to come as the fifteenth, since $8+15=p+1=23$; where p means the period of 1/23. Again, 4 will appear as the sixteenth remainder, since the square of any remainder always turns up at double the distance of the remainder itself, &c.

As mentioned in a previous number, when the period is even, the remainders recur after $(P-1)/2$ values but with

the negative sign. Thus the remainders of 1/19 are 10, 5, 12, 6, 3, 11, 15, 17, 18; and the rest are simply these subtracted from 19, viz. 9, 14, 7, 13, 16, 8, 4, 2, 1.

Notice, too, that each of these remainders is half of its predecessor (subtracting 19 when necessary), just as we got the figures of the period itself by doubling: this law also is general, but each fraction has its own multiplier thus:—

1/19 = ·0̇, 5, 2, 6, 3, 1, 5, 7, 8, 9, 4, 7, 3, 6, 8, 4, 2, 1̇.
Remainders = 10, 5, 12, 6, 3, 11, 15, 17, 18, 9, 14, 7, 13, 16, 8, 4, 2, 1.

The second remainder is 5; and 25, that is $25-19=6$, is the fourth remainder.

2 is the third remainder; and 144, that is $144-19\times7=11$, is the sixth remainder.

6 is the fourth remainder; and 36, that is $36-19=17$, is the eighth remainder.

Again take

1/17 = ·0̇, 5, 8, 8, 2, 3, 5, 2, 9, 4, 1, 1, 7, 6, 4, 7.
Remainders = 10, 15, 14, 4, 6, 9, 5, 16, 7, 2, 3, 13, 11, 8, 12, 1.

4 is the fourth remainder, $4^2=16$ is the 8th.

5 is the 7th remainder; therefore 25, or $25-17=8$, is the 14th remainder.

In this case there are only 16 figures in the period, but it will be found that the law still holds good, thus

2 is the 10th remainder, $2^2=4$ should be the 20th remainder, $20-16=4$; it is also the 4th remainder in the series.

There is quite a budget of other facts connected with remainders, but I must not intrude further on your space.

Robt. W. D. Christie.

Wavertree Park College, Liverpool.

FLYING DRAGONS.

To the Editor of Knowledge.

Sir,—I am most reluctant to burden your columns with this discussion, but Mr. Lydekker dismisses Prof. H. G. Seeley's careful and exhaustive work on the homology of the *manus* of Pterodactyles with the curt assertion that it "has fallen into oblivion," though I am not aware that Prof. Seeley himself has admitted the "oblivion," or changed his view; and I suppose that he stands in the first rank as a comparative anatomist. When and by whom have his views on the radial origin of the metacarpal carrying the membrane of flight been successfully disposed of? The figure given in Knowledge undoubtedly seems to lend itself to the ulnar view of attachment; but I have not seen the original, and we know how liable a draughtsman is to misinterpret a fossil. In *P. longirostris* the radial origin of the bone seems to me beyond the possibility of dispute.

A quotation from Prof. Newton's article on *Archæopteryx* is not relevant to the discussion on the (very different) Pterodactyles proper. I am quite aware of the work that has been done on the former (especially Dr. Haeberlein's specimen), which demonstrates completely the ulnar origin of the metacarpal of flight, and, *pro tanto*, certainly tends to remove this form out of the line of avian ancestry, in spite of the remarkable and indisputable "flight feathers." While the strong, and radially attached (as Prof. Seeley contends) flight-carrying metacarpal of Pterodactyles suggests a powerful means of aërial progression, the ulnar support of the feathers in *Archæopteryx* seems to me to afford a presumption that these animals were mere "potterers" in flight from tree to tree, or rock to rock.

Yours truly,
Arthur Nicols.

Watford, May 19, 1890.

[In reference to the above, I confess that I have no means of knowing whether the author of the theory that the wing-bearing digit of the Pterodactyles corresponds to the index finger of the human hand (first published in the work entitled *Ornithosauria*, p. 53; Cambridge, 1870) still holds the same view; but I will venture to say that, if he does so, he is the only one among those capable of forming an opinion who adopts this interpretation. So far as I can see, there was no evidence to support this view at the time it was published; and I observe that in the edition of *Phillips' Geology*, published by Messrs. Etheridge and Seeley in 1885, it is stated in Part I., p. 518, that *a digit* was elongated to support the wing-membrane; thus carefully avoiding the crucial question.

Your correspondent suggests that the figure to which I have referred was "doctored." Now that figure was taken from Prof. Huxley's *Manual*, which ought to be a guarantee for its authenticity; and it is, indeed, practically a copy of the original specimen. The latter is, I believe, in the museum at Munich, but there is a cast in the British Museum (Natural History).

If your correspondent requires further evidence in support of the generally accepted view, I would advise him to consult the memoir of Prof. von Zittel, published in vol. xxix. of the *Palæontographica*. The left wing of a Pterodactyle figured in Plate X. of that memoir (the ventral aspect being exposed) affords incontrovertible confirmation of the ordinary view. If, moreover, he will take the trouble to visit the Natural History Museum in Cromwell Road, he will see in the bays on the left side of the entrance hall a cast of this specimen with the bones labelled, under the immediate superintendence of the director—Prof. W. H. Flower—in the manner indicated in my article.

With regard to *Archæopteryx* your correspondent is involved in a hopeless "muddle." If I may again refer him to Prof. Newton's article *Ornithology* (not *Archæopteryx* as he quotes it), he will find that *Archæopteryx* is regarded as on the direct ancestral line of modern birds, and is itself an extremely generalised bird. Instead of "the *ulnar* origin of the metacarpal of the organ of flight," the wing of *Archæopteryx* is essentially the same as that of a modern bird, with the exception that the thumb is perfect. The main digit is the second or index of the human hand, and is therefore *radial*.

Finally, I must decline to be drawn into any further discussion of this subject, which is really beyond the limits of controversy.—R. Lydekker.]

To the Editor of Knowledge.

Sir,—Mr. Field's interesting remarks on Spiders in this month's issue of Knowledge tempts me to say a word or two about these creatures, by way of supplement. The information I owe to the kindness of a friend, who was resident for many months in Texas. He assures me that the bite of Tarantula spiders, at least in Texas, is exceedingly dangerous, and that he has not known a case in which the person bitten has recovered, though he believes that such cases are known. There is a common saying among the Texan cow-boys, to the effect that a man who is bitten by a Tarantula had better "say his prayers and take his boots off," for these sons of the desert have a dread of dying with their boots on!

Yours faithfully,
E. H. Blakeney.

Trin. Coll., Cambridge, May 8.

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SOUND OF THE AURORA.

To the Editor of Knowledge.

Sir,—I have observed the remarks made by J. Shaw at pages 138-39 of the May number, and was somewhat surprised to learn the phenomena was considered rare.

Between the years of 1840 and 1847 audible auroras were frequent and common. In the last-named year I recollect one evening, about the end of September or sometime in October, as we were harvesting corn after sunset, there being no moonlight, the aspect of the sky was dull and other signs prognosticated rain. The aurora was tinted with green, yellow, and purple, and moved rapidly from east to west, in striæ, the sound being high or low according to the motion, often resembling what your correspondent describes, but at other times thunder or artillery at three or four miles distance.

Yours faithfully,

Auchenraith, Blantyre. Wm. Thomson.

TEETH AND THEIR VARIATIONS.

By R. Lydekker, B.A.Cantab.

To most persons the chief interest in connection with teeth is an unpleasant one, owing to the circumstance that through an artificial mode of life these highly important organs are subject to a premature decay, and thus fail to perform satisfactorily their proper function. With less civilised and savage races this, however, is not the case, and among such peoples the teeth, almost without exception, last in a sound and useful condition throughout life, being gradually worn down to their very roots with advancing age, and thus showing a natural connection between the capacity of the teeth to withstand wear and the normal span of human life.

Regarded, however, from an anatomical point of view, teeth are among the most interesting parts of the animal organisation with which the naturalist has to deal, owing to the great and characteristic variations they display in the different groups of Vertebrate, or Back-boned Animals, and to the frequency with which they are preserved in a fossil condition when other parts of the skeleton have either perished or are only preserved in a very imperfect condition. True teeth are found only among the Vertebrate animals, and in the following pages we propose to take a short glance at some of the most striking variations displayed by them among certain groups of the class of Mammals, although some mention will also be made of those of the lower types.

Curious as it may at first sight seem, the researches of modern naturalists have now conclusively proved that primarily teeth are neither more nor less than special modifications of small bony structures found in the external skin of some of the lower Vertebrates, of which the best known example is afforded by the hard granules in the skin of the Sharks, commonly known as shagreen. The teeth of some fishes depart, indeed, but very slightly from these simple bony granules; and a gradual transition can be traced from these to the most complex types of teeth found in the whole Vertebrate group.

In speaking of these simple teeth as bony structures, we have used the word bony in a somewhat popular sense, for, strictly speaking, teeth are not composed of true bone. Indeed, in the majority of Vertebrates, the teeth consist either of two or three perfectly distinct structural elements, which can be easily recognised by the naked eye. Thus in the human teeth, for instance, the outer surface of the exposed portion, or *crown*, as it is technically called, is seen to be uniformly coated with a bluish-white and highly polished substance of exceeding hardness, which is conveniently known as the *enamel*. On looking at the grinding surface of a tooth which has been somewhat worn, it will be seen that this enamel only forms a comparatively thin outer layer, and that the inner part of the tooth consists of a yellowish substance, which is much softer, and is termed the ivory or *dentine*. Further, when a human tooth is removed from its socket, it may be observed that the *root*, or embedded portion, is overlain by a very rough-looking bony substance, to which the name *cement* is applied, and which directly overlies the dentine. In the human teeth this cement is confined to the root, but in some other Mammals it also extends on to the crown, where it overlies the enamel; and we thus see that the crown of a tooth may consist of three distinct elements, of which the dentine forms the central part, which is overlain by the enamel, and this again by the cement.

Fig. 1.—The Crown of a Tooth of an Extinct Reptile, with a magnified view of the notches on the margin.

In many Fishes teeth are distributed irregularly, or at other times in a well-defined pattern, over the whole of the surface of the mouth; and we also find that some Reptiles have the roof of the mouth more or less covered with teeth. In the majority of the higher Reptiles—such as Lizards and Crocodiles — the teeth are, however, confined to the margin of the upper and lower jaws, where they form a single row, with the base of each tooth either embedded by an undivided root in a groove or socket of the jaw-bone, or absolutely welded to the bone itself. A common type of Reptilian tooth has the crown forming a more or less compressed cone (Fig. 1), with a pair of sharp-cutting edges, which may or may not be furnished with saw-like notches. In the great majority of Reptiles the whole of the teeth are of the same pattern, although in some cases —as the Crocodiles and Alligators—one or more of the teeth in either jaw may be much larger than the others; and in a few extinct types (Fig. 2) the teeth are divided into three distinct series. As one tooth comes into use it is succeeded from below by the germ of another, which gradually grows up and absorbs its roots till the old tooth finally drops out, this process going on without intermission during the whole life of the animal, so that a practically endless succession of teeth is developed.

Fig. 2.—Skull and Teeth of an Extinct South African Reptile.

Starting from a tooth of the simple conical type of the one represented in the first woodcut, it is possible to evolve therefrom the whole of the curious modifications of tooth-structure found in the higher Vertebrates. The first stage in the process is the development of small points, or cusps, on either side of such a cone, as is seen in the hinder teeth of the skull of an extinct reptile shown in Fig. 2. A further step is for these side cusps to become nearly or quite as large as the main original cone, and also to be twisted round upon the same, so that in the upper jaw (as

is shown in the hinder teeth of the Civet, figured in wood-cut 3), each upper tooth has one inner and two outer cusps, while exactly the reverse arrangement obtains in the teeth of the lower jaw. The addition of extra cones or cusps to this triangular form of tooth, with alterations of the simple cusps into ridges by union with one another, or by flattening in one direction or another, or by increase in their height, will produce all the complicated hinder teeth of the higher Mammals.

Before going any further, we must, however, notice some of the points by which the teeth of Mammals are distinguished from those of Reptiles. Exclusive of certain peculiar types like the Porpoises and Dolphins, which can be readily explained, the teeth of Mammals are not similar to one another throughout the jaws, but are arranged in groups of different sizes and series. Thus in the upper jaw (Fig. 3), there are commonly three simple front, or *incisor*, teeth with chisel-like crowns; then comes the single large *tusk*, behind which are the *cheek-teeth*, of which the number is very frequently seven, although there are only six in the figured jaw. In those Mammals which live on an animal diet, the three or four foremost of the cheek-teeth (Fig. 3) retain a more or less near approximation to the original compressed conical form, only the hinder ones acquiring broad and flattened crowns adapted for masticating or grinding. But in some of the herbivorous species, on the contrary, as the Horse, all the teeth

FIG. 3.—THE TEETH OF THE LEFT SIDE OF THE UPPER JAW OF THE INDIAN CIVET.

behind the tusk may acquire these greatly developed and flattened crowns.

In the division of the teeth into incisors, tusks, and cheek-teeth, the peculiar extinct Reptile from South Africa of which the skull is shown in Fig. 2, agrees with Mammals, but it differs in that each cheek-tooth is fixed in the jaw by a simple undivided root, whereas, in all mammals (with the exception mentioned), these teeth are implanted by two or more *fangs*; the number of these fangs being greatest in the hindmost teeth, as all those who have had the misfortune to part with a *back-grinder* under the hands of the dentist know only too well.

Again, there is another very important feature by which the teeth of the great majority of Mammals are distinguished from those of Reptiles. As we have already mentioned, the old teeth of most Reptiles are being continuously and irregularly replaced by new ones throughout the life of their owners; but in Mammals there is only one such replacement during the whole of life, and that only of a certain definite number of the teeth. In the article on Marsupials, published in the May number of KNOWLEDGE, it has been stated that in that group of Mammals there is only one tooth on either side of each jaw which is so changed, that tooth corresponding to the eighth tooth from the front in Fig. 3. In the case, however, of a Mammal with a dentition like that represented in the figure last mentioned all the teeth in advance of the last two, with the exception of the small one immediately behind the tusk, have been preceded by *baby-*, or *milk-teeth*, that is to say with teeth corresponding to such of those of the human child as are gradually replaced by larger successors with advancing age. The last teeth of a Mammal, two in Dogs and Civets (Fig. 3), but three in man, have, however, no such milk-predecessors, and are hence called *true grinders*; the teeth between these latter and the tusk, which are only four in number in Man, against four in the Civet, Dog, and Pig, being termed the *false grinders*.

This single definite replacement of a certain number of teeth—it may be of only one, or it may be of seven or eight on either side of each jaw—is, therefore, a peculiar feature of Mammals, and indicates the highest and most nearly perfect phase of the development of the tooth-series.

Having thus acquired a general idea of some of the more important characteristics distinguishing the teeth of Mammals as a whole, we are in a position to enter into the consideration of their structure in any particular group. Perhaps one of the most interesting of all groups in regard to the gradual development of a highly complex structure in the cheek-teeth of the modern form, is that of the Hoofed or Ungulate Mammals; or that extensive order which includes the three great groups of Pigs, Deer, Antelopes, and Cattle; Tapirs, Rhinoceroses, and Horses; and, lastly, Elephants. The animals of the first group are all related to one another by the structure of the feet, in which the two middle toes are symmetrical to one another; and we can trace in this, as well as in the two following groups, a gradual increase in the complexity of the teeth, as we proceed from what naturalists term the generalised to the specialised types; the latter being, it need hardly be mentioned, mainly characteristic of the present day and the latest geological period, while the former are mostly of earlier origin.

FIG. 4.—THE LAST THREE LEFT UPPER CHEEK-TEETH OF AN EXTINCT PIG.

The simplest form of cheek-tooth in this group is found among certain extinct animals closely related to the modern Pigs, three of these teeth being represented in Fig. 4. It will there be seen that the crown of each of these teeth carries four comparatively low and simple cone-like prominences, the number of these cones being one added to the primitive type of triangular tooth mentioned above. These cones, it will be observed, are separated from one another by an X-shaped shallow depression or valley; and when their summits become somewhat worn down by use (as in the tooth on the left of the figure), it will be seen that nearly circular islands of dentine are exposed. The figure also shows that the last tooth is rather larger than either of the others; this being still more markedly the case with the corresponding tooth in the lower jaw. In the modern Pigs this last lower tooth (Fig. 5) becomes still larger; while, as may be seen from the figure, the cones of all the teeth have now lost the simple form of the earlier species, and have been thrown into "puckers," so that when worn the exposed islands of dentine have an irregular shape with "crinkled" edges. From the hillock-like formation

FIG. 5.—THE LAST RIGHT LOWER CHEEK-TOOTH OF A PIG.

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of these teeth in the Pig family, the term *bunodont* (Gr. *bounos*, a hillock) has been proposed for this type of dental structure. In correlation with this comparatively simple type of cheek-teeth, it should be mentioned that the Pigs have incisor teeth and large tusks in both jaws; while their feet agree with those of ordinary mammals in having the middle metacarpal and metatarsal bones (or the bones immediately below the wrist and ankle) separate from one another.

Fig. 6.—An Imperfect Left Upper Cheek-Tooth of an Extinct Selenodont Pig-like Animal.

From the type of tooth represented in Fig. 4, other fossil forms exhibit a complete transition to the imperfect tooth represented in Fig. 6. In addition to the immaterial point of its larger dimensions, it will be noticed that the latter has five cones, a minute cone visible in Fig. 4 having now developed into one of nearly equal importance with the others. The most remarkably feature connected with this type of tooth is, however, that all the cones have been compressed from side to side, and have acquired a crescent-like curvature, so that the worn surfaces of dentine are crescent-shaped, and the cones themselves should more properly be described as crescents. Hence this type of tooth has been described as the *selenodont* (Gr. *selene*, the moon, and hence a crescent) modification. It will be observed that in this form of tooth the crescents are still low, and the valleys separating them quite shallow; and it is further evident that the complicated grinding surface thus produced is one better adapted for the thorough mastication of substances like grass than that of the teeth shown in Fig. 4, thus enabling its owner to obtain a better sustenance out of such herbage. With Fig. 7 we come to the tooth of another extinct animal of this group, in which the fifth crescent has been lost, while the four main crescents have become decidedly more deeply curved and somewhat higher, although the bottom of the intervening valleys is still more or less distinctly visible. The worn surfaces of dentine, it will be noted, are quite V-shaped.

Fig. 7. — A Right Upper Cheek-Tooth of an Extinct Animal intermediate between the Pigs and the Deer.

(*To be continued.*)

RAPID EXPOSURE PHOTOGRAPHY.

THE commonly used term "Instantaneous Photography" is of course a misnomer; some time is always necessary to impress a developable image on the sensitive plate. Prof. W. H. Pickering (who has kindly lent the negatives from which the photographs which accompany this paper are copied) has devised some ingenious methods for accurately measuring such short intervals of time.

It was suggested in the *British Journal of Photography*, as early as August 1883, that photographs of the spot of sunlight reflected from a freely falling glass ball might be utilised for determining the duration of short exposures. The suggestion occurred to Prof. Pickering that the resistance of the air might be of sufficient importance to vitiate determinations based on the ordinary law of falling bodies, and that the retardation caused by the resistance of the air ought to be measured experimentally. For this purpose a glass ball silvered on the inside, such as is used for Christmas trees, was procured. It measured 4·15 cm. in diameter, and weighed 25 grams. Some white silk threads were attached to a blackened board so as to form a scale of equal parts; and this being set in the sunlight, the ball was dropped by its side into a box filled with cotton wool. A mirror was attached to the arm of a tuning-fork of known pitch, and a camera with a rapid exposing shutter was placed so as to photograph the image of the ball as seen in the mirror. The fork was set in vibration and the ball dropped. On development the plate showed a black sinuous line, the curves of which were near together at the top, but gradually widened out as the ball approached the bottom of its course. Several photographs were taken and measured under a dividing engine, with the result that when allowance was made for the angular motion of the spot of light on the ball as it changed its position with respect to the camera, and comparison was made with the theoretical motion of a ball dropped in vacuo, the retardation was found to be proportional to the distance traversed, and to amount to $\frac{3}{100}$ths of that distance. The maximum fall measured was one meter. With heavier balls the retardation is proportional to the square of the diameter of the ball, and inversely as its weight.

Hence, for measuring the duration of drop-shutter exposures, we may calculate the retardation, and, as Prof. Pickering has ingeniously pointed out, we may neutralize its effect, by dropping the ball at a short distance in front of the scale to be photographed. In the case of the light ball, above described, the distance in front of the scale should be $\frac{3}{100}$ths of the distance between the scale and the lens. At a given signal the ball is dropped, and the exposure released. A long black line is produced upon the plate, from the length of which the duration of the exposure may be calculated with considerable accuracy. Four or five exposures may be made on the same plate, moving the camera slightly after each one. The results obtained will enable the experimenter to determine whether the exposures are all of uniform duration.

For exposures longer than $\frac{1}{30}$th of a second, Prof. Pickering employs another method of measuring the duration; it consists in photographing a seconds pendulum having a silvered glass ball for a bob. The pendulum is placed in the sunlight and is swung before a painted scale, spaced out on the arc of a circle whose radius is thirty-nine inches. It is symmetrical on both sides of the middle point, and distances are measured both ways, each corresponding to the space traversed by the pendulum in 0·02 seconds. To traverse the last space requires ·1 second.

Prof. Pickering finds that for objects in full sunlight an exposure of $\frac{1}{200}$th of a second is needed to give a fair printing negative, with the plates and rapid rectilinear lens he has been using. Such exposures may be obtained with comparative uniformity with a spring shutter; and much shorter exposures have been made by this means, when photographing the direct image of the sun thrown by a telescope.

The photographs reproduced in the plate have been copied from negatives kindly sent to England for use in Knowledge by Prof. W. H. Pickering. The photographs of the splashing water were taken with an exposure of $\frac{1}{30}$th of a second. The splash was caused by dropping a six-inch stone mortar into a pail from a height of six or seven feet. In most instances the water seemed to ascend in a

Photographs taken by Prof. W. H. Pickering, with Exposures of $\frac{1}{50}$th of a Second, of Three Splashes caused by a Stone falling into a Pail of Water; and Photograph of Water beginning to Flow from an Inverted Bottle.

vertical column to a height of three or four feet, as in the photograph in the left-hand bottom corner. The splash seems to consist of a series of more or less circular waves, the outer ones of which move upwards with less velocity than the inner waves or sheets of water, different parts of each sheet evidently move with different velocities, so that the edge of the wave is notched or fringed, and afterwards breaks irregularly into streams or drops, which fly away in trajectories. Lord Rayleigh has shown that the breaking up of a stream of water into drops is closely connected with its electrical condition. A small fountain, consisting of a thin stream or column of water, makes an excellent electrometer, which answers in the most sensitive manner to the approach within a foot or so of a rubbed glass rod or stick of sealing-wax.

The right-hand lower picture shows water flowing from a flask just after it has been turned upside down—the water does not drop directly from the mouth of the flask, but flows outward in streams, whose initial direction appears to be governed by the curvature of the lip of the flask. Each drop, when formed, reflects the sun's image, and traces a line on the sensitive plate which corresponds in length to the velocity with which the drop is moving.

Sensitive as are the salts of silver in the dry plates at present in use, they do not correspond in sensitiveness with the living matter of the retina, on which images of comparatively faint objects are continually being impressed and obliterated. When we look at a faint object and the pupil is fully expanded, the eye may be compared to a camera with a focal length of about four times its aperture. With such a camera it would be useless to attempt to photograph objects illuminated by candle-light in a fraction of a second. Yet the eye will perceive a succession of such faintly illuminated objects in a small fraction of a second, as anyone may satisfy himself by watching any quickly-moving objects illuminated by the light of a candle, or even by a much fainter light.

A. C. R.

HOUSE-FLIES AND BLUEBOTTLES.—IV.

By E. A. Butler.

THE description given in our last paper of the mouth organs of the bluebottle will not apply without considerable modification to our fifth species, *Stomoxys calcitrans*. This, it will be remembered, is the blood-sucking fly that has the annoying habit of piercing our skin in a manner which reminds us of gnats and mosquitoes. No one can look attentively at this fly without suspecting it of possible powers of annoyance; the needle-like proboscis, projecting straight forwards like a lance ready for action, looks vicious enough, and by the weapon of which it forms the sheath the insect can certainly make a sharp and painful puncture. Apparently, however, its powers in this direction have been somewhat exaggerated; such, at least, is the writer's own experience, and although the puncture is irritating enough at the time there are no painful after-effects as in the case of gnats and mosquitoes.

With the naked eye we see in this proboscis nothing more than a black, slightly curved, rod-like organ, projecting nearly horizontally from the lower margin of the head. A hand lens shows it as a somewhat cylindrical, polished rod, enlarged towards the base, and with the free end considerably more rounded and less acute than it appeared before. The compound microscope exhibits it as a highly polished, deep brownish-black body (Fig. 9) closely covered, from the base to near the tip, with minute grooves marking it transversely; at the base these are at right angles to its length, and this direction is preserved till about the middle of the more slender part, where they begin to slope towards the tip, the inclination gradually increasing up to the place where they cease, a little before the tip. At the hinder end of this hard, polished body is a funnel-shaped piece running up perpendicularly to attach the whole organ to the head. On the front edge of this are the maxillary palpi, differently shaped from those of the bluebottle, being more uniform in diameter throughout, and therefore slenderer and less club-shaped. At the tip of the proboscis are the labellæ, fringed with hairs, as in the bluebottle, but they are reduced to very small dimensions and scarcely exceed the rod-like portion in diameter. This is all that can be seen superficially.

If, however, the organ be severed from the head and pressed, it is soon discovered to be grooved, and from the groove on the upper surface shoots out a long blade, like that of a penknife, with an exceedingly sharp tip (Fig. 10). This lancet is the weapon that does the mischief when the fly settles on one's hand for a draught of blood. It is sufficiently strong to be able to perforate a thin garment, and reach the skin beneath. Under a high power of the microscope its whole surface, except the extreme tip, is seen to be beset with excessively minute hairs.

All the five species of flies of which we have hitherto been speaking pass through practically the same series of changes in the course of their life. The long oval eggs are produced in great numbers, and are laid on the substances which are to serve as food for the larvæ. This is different in different cases. The bluebottles select flesh, either raw or cooked, and even wounds in the living animal are not exempt from their attacks. The frightful story of "Old Prue" in *Uncle Tom's Cabin* has had its counterpart in real life, and the torments of the wounded on a field of battle have sometimes been increased in this loathsome way. In the summer-time no animal substance can be long exposed without being visited by these and other flesh-devouring flies; but if it is in the open air, the chief visitor is likely to be the flesh-fly, *Sarcophaga carnaria*, a voracious devourer of animal matter, which, however, rarely enters houses. It is quite different in appearance from these others, being prettily chequered with black and white. The larger house-fly does not select meat, but deposits its eggs amongst stable refuse, as the larvæ feed upon horse-dung, of which they eat the softer decaying parts and leave the bits of hay and straw. The smaller house-fly (*H. canicularis*) selects decaying vegetable matter; but *Stomoxys*, like *M. domestica*, prefers the manure heaps.

Closely connected with the extraordinary nature of the food of the larvæ is the rapidity with which these flies pass through the earlier stages of their life. As an influence tending towards shortness of larval life, we may no doubt reckon the fact of the great abundance of food amidst which the larvæ find themselves immediately on being hatched; they have literally nothing to do but to eat. No exertions of their own are necessary to procure food; it is all ready to hand. And, again, the condition in which the food is found—putrefaction having probably already set in—necessitates haste if the grubs are to anticipate the ordinary chemical processes of nature and seize upon the food material while it is still in the condition of organic compounds, and before it has passed into the greater simplicity of combination which restores it to the inorganic world and renders it unfit to support animal life. The eggs, therefore, are hatched very soon after being laid, only a few hours intervening between their deposition and the appearance of larvæ. The eggs of the flesh-fly above-

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mentioned (*Sarcophaga*) are, indeed, hatched *before* they are laid, *i.e.* while still in the abdomen of the mother, so that they are laid as living maggots ready at once to commence the work of their life. Most of these flies, too, are gifted with extraordinary fecundity, a fact which, while it adds to the annoyance we receive from the perfect insects, at the same time considerably increases the counterbalancing benefits conferred on the world at large by the continued and extensive consumption of putrefying matter.

The eggs are of a long oval shape, opaque, and of a dull chalky colour. Great numbers are laid in a single batch; a solitary house-fly, which had been enclosed in a bottle, was observed by Dr. Packard to lay 120 eggs in the course of fourteen hours. These were deposited in piles, or stacks, loosely at the bottom of the bottle. Twenty-four hours after the completion of the laying, some had already hatched, and the rest very soon followed suit. As such a degree of fecundity was manifested when no manure was at hand, and the circumstances were therefore unfavourable, it seems probable that the number would have been exceeded in the open under natural conditions. If a little fresh horse-dung be exposed at an open window during the month of August, the flies will soon discover it, and may be watched as they proceed to lay their eggs in all the little crannies they can discover.

Fig. 9.—Proboscis of Stomoxys Calcitrans. *m*. Maxillary palpi.

Fig. 10.—Lancet of Stomoxys Calcitrans.

The larvæ are all similar in appearance, whitish, footless grubs, known as maggots or gentles (Fig. 11, *a* and *b*). Their shape is rather difficult to determine by observations on the living specimens, as the skin is soft and flexible, and they are in continual motion, contracting or relaxing their muscles, and thereby perpetually altering their form. When still, they are of a somewhat conical form, the anterior end being the smaller of the two. They subsist not merely on the juices, but on the more solid matter of the mass of corruption amongst which they find themselves, and hence, unlike the perfect insects, are furnished with a biting apparatus, which is in the form of two strong hooks. These are cast off when the pupa stage is reached, and left behind in the pupa case on the emergence of the perfect fly. The trifling amount of locomotion necessary to the maggot is performed by muscular contortions of the body, aided by the hook-like jaws, and by rows of tiny hooks at the junctions of the segments. The larval life, as we have already said, is but short; that of the house-fly, for example, lasts about a week, during which time the maggot is said to change its skin twice, altering its form to some extent on each occasion. By the end of this time it is full-grown, and passes into the pupa condition, which in about another week gives place to the perfect form. The larvæ are apparently tenacious of life, and can continue to exist even under very unfavourable conditions. Thus it is recorded in the French *Naturaliste* of the maggots of a bluebottle, that they had been put into an aquarium to serve as food for the newts, and two days afterwards they were still alive, and some had even changed into pupæ, though at the bottom of the water. They are very dependent on temperature, and unless there is sufficient warmth their development is delayed and they become more or less dormant; hence all specimens that are in the larval or pupal condition at the approach of winter have their further development stopped, and remain in a torpid condition till the returning warmth of spring enables them to complete their cycle of changes.

The pupæ are extremely peculiar. With most insects, it is customary for the pupal condition to be assumed by means of a casting of the last larval skin. Such, however, is not the case with these flies; but, instead, the last larval skin simply hardens and is not shed at all, the true pupa being formed inside it. In most cases, the larva burrows into the ground before accomplishing this change. The hardening process appears to be completed very suddenly; the skin contracts, especially in length, and becomes hard, brittle, and dark coloured, until what was a few minutes before a soft, wriggling, conical maggot, becomes a short cylindrical body with rounded ends (Fig. 11, *c*) enveloped in a hard, reddish-brown skin, faintly marked

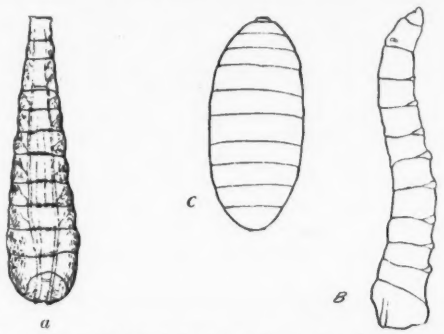

Fig. 11.—*a*. Newly-hatched Larva of House-fly; *b*. More advanced Larva of same; *c*. Puparium of same. (After Packard.)

with a succession of grooved rings transversely to its length, and utterly incapable of the slightest movement. Evidently, therefore, this so-called pupa is not strictly comparable to the chrysalis of a butterfly or moth, notwithstanding some superficial resemblance. Each, it is true, is covered by a hard reddish-brown skin; but that of the moth is the true pupa skin, whereas that of the fly is not a pupal skin at all, but the last larval skin, and corresponds to the thin, crumpled and collapsed skin that is left at the tail end of the moth's chrysalis. The true pupa skin of the fly is to be found inside, in the shape of a thin membrane in which the contained pupa is enveloped. Such a pupa is described as *coarctate*, and the brown skin is called the *puparium*.

When the fly is ready to issue from the pupa-case, it is found to be furnished with a large membranous protuberance on the head between the eyes. This is the outer surface of a hollow sac which is capable of great distension, and is used in pushing off the top of the barrel-shaped pupa case, which separates along the line of one of the circular grooves. By muscular contractions the fluids of the body are forced into this sac, distending it, and causing it in turn to press against and ultimately force off the lid, thus liberating the fly. In Fig. 12 the insect is shown just after the lid has been forced off, with its body still enclosed within the lower part of the pupa-case, and the distension of the frontal sac is still at its height. The

fly soon wriggles out of the case, and, while its body is still soft and pale, runs about with its wings in a crumpled and baggy condition; as it thus runs along, the membranous sac on the head alternately dilates and contracts, being connected with the breathing-tubes. But as the skin gradually hardens and the wings become fully expanded, the movements of this sac become less perceptible, and finally, when the hardening process is completed and the fly is ready for flight, all power of dilatation is lost.

FIG. 12.—FLY IN PUPARIUM, lid removed. *a*, Frontal sac.

It is impossible to speak definitely with regard to the duration of the life of the perfect fly, but it would appear to be longer than that of the larva and pupa, except when these exist through the winter. Bluebottles are often caught with very ragged edges to their wings, and with their proper proportion of hairs much reduced, both of which mutilations seem to imply a good deal of knocking about in the world. In addition to this, bluebottles, at least, hybernate, and are thus able to exist from one year into the next, though probably only a very small proportion of the specimens of a given season survive in this way. During the winter they stow themselves away in the most perfect concealment in unsuspected corners and crevices, from which, however, an unexpectedly warm and sunny day in spring will at once entice them. Most people have probably noticed the sudden appearance of flies on such occasions, and their equally sudden and complete disappearance as soon as the weather becomes cold again, when they retire again to their hiding-places. In cold weather they appear to be partly paralysed, and have scarcely any power over their wings, and but little over their legs. They are truly creatures of the sunshine.

(*To be continued.*)

THE FACE OF THE SKY FOR JUNE.

By HERBERT SADLER, F.R.A.S.

DURING the month of June there will be no real night throughout the British Islands, but either daylight or twilight. There will be an annular eclipse of the sun on June 17th, visible as a partial eclipse in the British Islands. At Greenwich the eclipse begins at 8h. 20·3m. A.M., the first contact taking place at an angle of 103° from the vertex towards the West (for direct image); the greatest phase is at 9h. 23·0m. A.M., when $\frac{37}{100}$ of the solar disc will be hidden; the eclipse ends at 10h. 30·7m. A.M., at an angle of 140° from the vertex towards the East (for direct image). The eclipse will be annular in parts of N.W. Africa and S. Asia. Minima of the Algol-type variable δ Libræ (*cf.* "Face of the Sky" for April 1889) take place at 11h. 17m. P.M. on the 8th, at 10h. 51m. P.M. on the 15th, at 10h. 25m. P.M. on the 22nd, and at 9h. 59m. P.M. on the 29th. A maximum of the celebrated long period variable *o* Ceti (Mira) occurs on the 30th. Mercury is too near the sun to be visible during the first portion of the month. On the 20th he rises at 2h. 50m. A.M. (54m. before the sun), with an apparent diameter of $8\frac{3}{4}''$, and a northern declination of $17\frac{3}{4}°$; on the 30th he rises at 2h. 36m. A.M., or 1h. 12m. before the sun, with an apparent diameter of $6\frac{3}{4}''$, and a northern declination of $20\frac{3}{4}°$. He is at his greatest western elongation (22°) at 9h. A.M. on the 24th. He is in Taurus throughout the month; but while visible he does not approach any naked-eye star very closely. Venus is an evening star, setting on the 1st at 10h. 17m. P.M., or 2h. 12m. after the sun, with an apparent diameter of $11\frac{1}{2}''$ and a northern declination of $24\frac{3}{4}°$. On the last day of the month she sets at 10h. 11m. P.M., 1h. 53m. after the sun, with an apparent diameter of 13″, and a northern declination of 19° 0′. During the month she passes from Gemini into Cancer. On the 15th she will be in a line with Castor and Pollux, the two stars and the planet being about equidistant, and presenting a configuration somewhat resembling the belt of Orion on a larger scale. At 9 P.M. on the 23rd, she will be about 16′ due north of the 6th magnitude star of η Cancri; and on the nights of 24th and 25th she will be a little to the north of Præsepe. She now appears markedly gibbous. Mars is an evening star, rising on the 1st at 7h. 32m. P.M., with a southern declination of 23° 2′ and an apparent diameter of $19\frac{1}{4}''$. He is then about $45\frac{1}{4}$ millions of miles distant from the earth. On the 30th he rises at 5h. 7m. P.M., with a southern declination of 22° 41′, and an apparent diameter of $17\frac{1}{2}''$, being then about $49\frac{1}{3}$ millions of miles distant from the earth. He is at his greatest brightness on the 5th, and during the first half of the month presents an almost circular disc, becoming somewhat gibbous at the end of June. During the month Mars describes a retrograde path through a portion of Scorpio into the confines of Libra, but he makes no near approach to any conspicuous star. The minor planets Ceres, Pallas and Juno are still visible. Ceres souths on the 28th at 8h. 48m. P.M., with a southern declination of 14° 1′, and appears as a star of 8·0 magnitude. During the month she describes a short retrograde path in Libra, but does not approach any naked-eye star. Pallas souths on the 28th at 8h. $22\frac{1}{2}$m. P.M., with a northern declination of 24° 3′ and appears as a star of 9·0 magnitude. She describes a short retrograde path in Böotes during the month, to the N.W. of W., but without closely approaching any naked-eye star. Juno souths on the 28th at 9h. $33\frac{1}{2}$m. P.M., with a southern declination of 3° 4′, and appears as a star of 9·6 magnitude. She describes a short retrograde path through Ophiuchus into Serpens. On the evening of the 16th she is 29′ due north of the 3rd magnitude star δ Ophiuchi, and on the evening of the 23rd she is 13′ north of the 6th magnitude star Lalande 29,440 Serpentis. Jupiter is an evening star, and rises on the 1st at 11h. 47m. P.M., with a southern declination of 17° 42′, and an apparent equatorial diameter of 43·0″. On the 30th he rises at 9h. 50m. P.M., with a southern declination of 18° 12′, and an apparent equatorial diameter of $46\frac{1}{2}''$. The following phenomena of the satellites occur while the planet is more than 8° above, and the sun 8° below the horizon. A transit ingress of the first satellite at 1h. 44m. A.M. on the 2nd. A reappearance from occultation of the first satellite at 1h. 17m. A.M. on the 3rd. A transit ingress of the shadow of the first satellite at 2h. 27m. A.M., on the 9th. A transit egress of the second satellite at 2h. 18m. A.M. on the 11th. A reappearance from occultation of the third satellite at 1h. 3m. A.M. on the 13th. An eclipse disappearance of the first satellite at 1h. 37m. 52s. A.M. on the 17th, and a transit ingress of the shadow of the second satellite at 11h. 55m. P.M. the same day. A transit egress of the shadow of the first satellite at 1h. 9m. A.M. on the 18th. A transit ingress of the second satellite at 1h. 47m. A.M., and a transit egress of the first satellite at 2h. 6m. A.M. the same morning. An eclipse reappearance of the third satellite at 0h. 44m. 19s. A.M. on the 20th, and an occultation (disappearance) of the same satellite 9 minutes later. A transit ingress of the shadow of the fourth satellite at 0h. 39m. A.M. on the 25th, and a transit ingress of the shadow of the first

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satellite 4 minutes later. A transit ingress of the first satellite at 1h. 32m. A.M., and a transit ingress of the shadow of the second satellite at 2h. 32m. A.M. the same morning, the disc of one satellite and the shadows of three others being on Jupiter at the same time. A reappearance from occultation of the first satellite at 1h. 8m. A.M. on the 26th. An eclipse disappearance of the third satellite at 1h. 15m. 57s. A.M. on the 27th, and a reappearance from occultation of the second satellite 14 minutes later. Jupiter describes a short retrograde path in Capricornus, being about 12′ *p.* a little south of the 4th magnitude star θ Capricorni during the first two or three days of the month. On the night of the 13th he is 13¾′ due south of the 7th magnitude star Lalande 40,774; about a quarter of an hour after transit on the morning of the 18th of June, the planet will approach within 18″ of the 7th magnitude star—8·5 magnitude in Schönfeld s Durchmusterung—B.A.C. 7303; on the night of the 26th Jupiter will be about 9′ south of the 6½ magnitude star 21 Capricornus. Saturn should be looked for as early in the evening as possible, as he is rapidly approaching the West. He souths on the 1st at 5h. 22½m. P.M., and sets at 0h. 41m. A.M., having a northern declination of 13° 42′, and an apparent equatorial diameter of 17¼″ (the major axis of the ring system being 39¾″ in diameter, and the minor 7½″). On the 30th he souths at 3h. 37m. P.M., and sets at 10h. 47m. P.M., having a northern declination of 12° 53′ and an apparent equatorial diameter of 16½″ (the major axis of the ring system being 38″ in diameter, and the minor 6½″). At 11h. 30m. P.M. on the 8th, there may possibly be an eclipse of Dione. Saturn describes a direct path in Leo to the N.E. of Regulus. On the 12th he is about 24′ south of the 6½ magnitude star 34 Leonis. Uranus rises on the 1st at 3h. 23m. P.M., and souths at 8h. 45m. P.M., with a southern declination of 8° 22′, and an apparent diameter of 3·7″. On the 30th he souths at 6h. 49m. P.M., and sets at 0h. 11m. A.M., with a southern declination of 8° 15′, and an apparent diameter of 3·6″. He describes a very short retrograde path to the N.N.W. of 76 Virginis in a region barren of naked-eye stars, and is stationary on the last day of the month. Neptune is invisible. There are no very well marked showers of shooting stars in June. The moon is full at 6h. 34m. A.M. on the 3rd; enters her last quarter at 9h. 50m. P.M. on the 9th; is new at 9h. 58m. A.M. on the 17th, and enters her first quarter at 1h. 54m. P.M. on the 25th. At 6h. 57m. P.M. on the 1st, the 6th magnitude star ζ^1 (32) Libræ will disappear at an angle of 32° from the lunar vertex, and reappear at an angle of 218° at 8h. 2m. P.M. The same evening the 6th magnitude star ζ^3 (34) Libræ will make a near approach to the lunar limb at 8h. 31m. P.M., at an angle of 132° from the vertex, and the 6th magnitude star ζ^4 (35) Libræ will make a near approach at 9h. 53m. P.M., at an angle of 145° from the vertex. At 10h. 5m. P.M. on the 2nd, the 5th magnitude star ω Ophiuchi will disappear at an angle of 27° from the vertex, and reappear at 11h. 10m. P.M. at an angle of 270°. At 8h. 35m P.M. on the 3rd, the 5th magnitude star c^2 (51) Ophiuchi will disappear at an angle of 28° from the vertex, the moon being below the horizon of Greenwich at the time, and reappear at 9h. 37m. P.M. at an angle of 241° from the vertex. At 1h. 3m. A.M. on the 5th, the 6th magnitude star B.A.C. 6369 will make a near approach to the lunar limb at an angle of 170° from the vertex. At 1h. 2m. A.M. on the 9th, the 4th magnitude star τ^2 Aquarii (a wide, but pretty double star) will make a near approach to the lunar limb at 163° from the vertex. At 3h. 11m. A.M. on the 15th, the 6th magnitude star B.A.C. 1206 will make a near approach to the lunar limb at an angle of 163° from the vertex. At 9h. 59m. P.M. on the 29th, the 3rd magnitude star β^1 Scorpii will disappear at an angle of 67° from the vertex, and reappear at 11h. 13m. P.M. at an angle of 274° from the vertex; its 5½ magnitude companion disappearing and reappearing at almost the same moment and angle. A description of this multiple star is given in the "Face of the Sky" for May 1890.

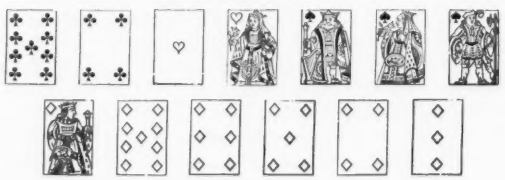
Whist Column.

By W. Montagu Gattie.

THE DISCARD—PLAYING TO THE SCORE.

WE conclude our series of hands in illustration of the principles of discarding with a hand intended to exemplify the importance of taking into account *the state of the score*. If it becomes apparent that a player must, in order to save the game, hold certain cards, the position of which is as yet undeclared, it is absolutely incumbent on his partner to assume that he has those cards, and to play as if they were marked in his hand. This consideration, which affects, of course, not only the discard, but all other points of play, is often overlooked, even by strong players; but it may not seldom be the means of saving an otherwise hopeless game.

Hand No. 11.

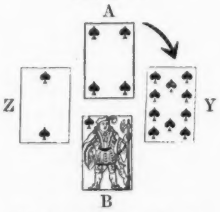


B's Hand.

Score—AB, 4; YZ, 1. Z turns up the Ace of Clubs.

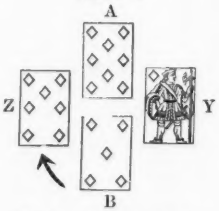
Note.—A and B are partners against Y and Z. A has the first lead; Z is the dealer. The card of the leader to each trick is indicated by an arrow.

Trick 1.



Tricks—AB, 1; YZ, 0.

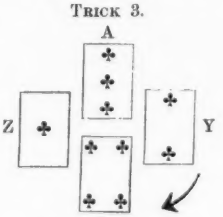
Trick 2.



Tricks—AB, 1; YZ, 1.

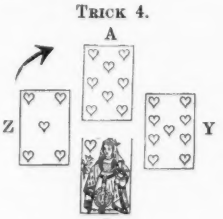
Notes.—*Trick* 1.—A has at least four spades. *Trick* 2.—Ace, queen, and ten of diamonds are all against B.

Trick 3.



Tricks—AB, 1; YZ, 2.

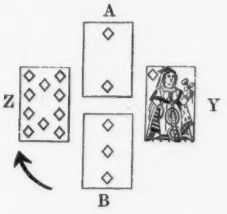
Trick 4.



Tricks—AB, 2; YZ, 2.

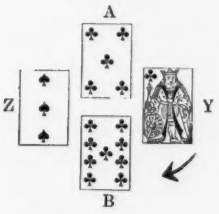
NOTE.—*Trick* 4.—Z has no more trumps. A has no heart smaller than the eight.

TRICK 5.



Tricks—AB, 2; YZ, 3.

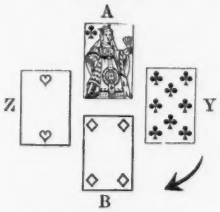
TRICK 6.



Tricks—AB, 2; YZ, 4.

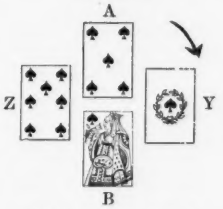
NOTE.—*Trick* 5.—B continues the diamonds, in preference to returning the spades, hoping that A may be void and may so be enabled to make a small trump.

TRICK 7.



Tricks—AB, 3; YZ, 4.

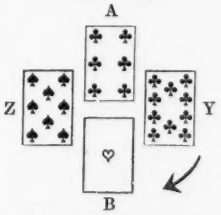
TRICK 8.



Tricks—AB, 3; YZ, 5.

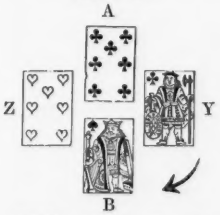
NOTE.—*Trick* 7.—Y holds knave, ten, of trumps, and YZ are "two by honours." *Trick* 8.—A has clearly led from a suit of four small spades. Besides B's king, the three spades unplayed are the nine, eight, and six; and of these A must hold two, but there is nothing to show whether his best is the nine or the eight.

TRICK 9.



Tricks—AB, 3; YZ, 6.

TRICK 10.

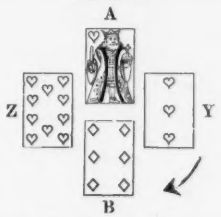


Tricks—AB, 3; YZ, 7.

NOTE.—*Trick* 9.—Y must make the two best trumps, and unless AB can make the three remaining tricks they lose the game. In order to make this possible, A must hold the two small trumps, and assuming this to be the case, as he has certainly two spades remaining, he can only have one heart, which may be either king, knave, or ten (see trick 4). It is also clear that B himself can only make two tricks (viz. with the ace of hearts and the king of spades), after which he will have to lead a losing diamond. It follows that the only chance of saving the game is to place the king of hearts with A, and to avoid blocking him by discarding first the ace of hearts and afterwards the king of spades. Then, provided that A has the best spade left (the nine), he will make the king of hearts and two spades, and so save the game. In short, the game is hopeless unless A holds two trumps, the king of hearts, and the nine and another of spades. B therefore plays as if those cards were marked in A's hand.

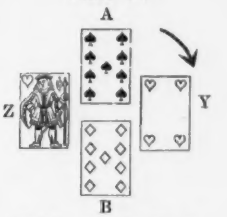
It might not answer the purpose to discard the king of spades first, for Y might be induced to lead a heart at trick 10 instead of drawing the trump. The discard of the ace of hearts makes the game perfectly safe if A holds the cards named; for, even if Y has a spade (the ten of spades at trick 1 may have been the commencement of a call), and leads it at trick 10, B, after winning with the king, will lead a diamond which A will ruff, and Y, after over-ruffing, will have to lead a heart.

TRICK 11.



Tricks—AB, 4; YZ, 7.

TRICK 12.



Tricks—AB, 5; YZ, 7.

TRICK 13.—A makes the last spade,

YZ SCORE THE ODD TRICK AND TWO BY HONOURS, AND AB SAVE THE GAME.

A's Hand	B's Hand.
C.—Qn, 7, 6, 5, 3.	C.—9, 4.
D.—8, 2.	D.—Kg, 9, 6, 5, 4, 3.
S.—9, 6, 5, 4.	S.—Kg, Qn, Kn.
H.—Kg, 8.	H.—Ace, Qn.

Y's Hand.	Z's Hand.
C.—Kg, Kn, 10, 8, 2.	C.—Ace.
D.—Qn, Kn.	D.—Ace, 10, 7.
S.—Ace, 10.	S.—8, 7, 3, 2.
H.—9, 6, 4, 3.	H.—Kn, 10, 7, 5, 2.

REMARKS.—*Trick* 1.—Looking at the state of the score, at A's weakness in the plain suits, and at the fact that the ace is turned up on his right, we think he properly abstains from opening trumps, even with five to an honour. *Trick* 6.—Z's discard is quite natural. B's *coup* could only have been frustrated by Z's retaining his spades throughout, in preference to the hearts, and throwing the ace of diamonds at trick 11; and Z could not know this until too late. *Trick* 7.—Y rightly continues the trumps, as B may hold the queen, and in any case Y remains with the absolute command.

We have received from Messrs. Longmans & Co. a copy of a new treatise, entitled *American Whist Illustrated*, by G. W. P., of which we hope to give a full notice next month.

Chess Column.

BY I. GUNSBERG (MEPHISTO).

[Contributions of general interest to chess-players are invited. Mr. Gunsberg will be pleased to give his opinion on any matter submitted for his decision.]

THE SAFE MAN.

There are three kinds of Chess-players! A few invent; many more exploit the inventions of the few; and the mass imitates them. To invent anything, requires instinct primarily as well as imagination. Chess-players possessing these qualities take their places as Pioneers abreast of the (Zeitgeist) craft of Chess, and by prospecting, and experimenting, and hazarding unknown lines of play, new theories,

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new views are brought to light, discoveries are made, and, generally speaking, their irresistible tendency to activity gives forward motion to the otherwise inert body of the exploiters and imitators. Thereby our knowledge of the theory of the game advances. This is equally true as regards the actual practice of the game, its spread, popularity, and general progress. The capacity for the difficult and important task of practically promoting and popularising Chess is based on the same qualities, and it effects the end in view in the same manner. The aptitude for the two kinds of work, though resting on the same basis, may nevertheless exist independently of each other. In rare individual cases only do we find that talent in both these directions co-exists, and that the same person is pre-eminently and successfully active as pioneer of the theory as well as of the practice of Chess.

The exercise of the superior qualities of imagination and invention necessitate a great expenditure of vital force and entail a large amount of risk, and its inevitable accompaniment of failure and disappointment; whereas the practice of the inferior act of exploiting and imitating the invention of others, is accomplished without any great effort of the imaginative or inventive faculties, and, with a lesser expenditure of vital force: there is naturally also reduced risk, and a minimum of failure in consequence of such play.

This being the respective and relative position of the few players of genius, and the larger number of laborious, and in some cases also talented, toilers who follow in their wake, let us just say a few words to relegate to their right place, and reduce to their proper proportions, the pretensions which have lately been advanced on behalf of the latter class, by means of statistics of averages in Tournaments such as were published lately in the *International Chess Magazine*.

Independent of the argument followed above, by which it will be seen that it is quite natural—though not inevitably so—that some players of the highest standard of excellence in Chess should have a comparatively larger amount of failures accompanying their great achievements, we may draw attention to the worthlessness of such calculations as any reliable guide, except to point to a moral the opposite of that intended by the calculator, namely, that the range of success of some players is confined within the powers of attainment possessed by a meritorious mediocrity; and that their performances always remain steadily on that level is also natural and in harmony with our opinion expressed above. But the players of genius will occasionally accomplish successes of a kind and quality which the safe man never has approached and never may hope to equal; simply because he does not possess the necessary genius for achievements requiring a lofty quality of Chess quite beyond his range and capacity. It must obviously be childish nonsense to put the performance of Zukertort in the London Tournament of 1883 on a par, for the purpose of arriving at a comparative average, with his play in the Nottingham Tournament of 1886. To be twenty times second at a small Tournament is still a vastly inferior performance to being first in the London Tournament of 1883, but, according to the person who strikes an average and who values quantity rather than quality, to be often second, or even third, in a Tournament like Nottingham produces a higher average than to be first in any one great Tournament and to fail in some others. The calculations have actually been reduced to an absurdity, as by means of them a player who has never won a first prize in any great International Tournament, and in all human probability never will do so, has been classified as of a higher average to another player who has won first prize in two great International Tournaments, and whose general status of strength is far superior to that of the former player.

This then is the safe man who never invents, never risks anything, but keeps any such inclination, if it does exist, under effective restraint. His laborious play only equals the effort made on his behalf, by laborious figures, to endow him with a value and importance which he does not possess, and to raise him by means of his fairly and hard-earned average success to a high estimation which the public will never agree to. Is it, therefore, worth while to curb all ambition, stint imagination, stifle enterprise, by avoiding all risk in order to attain such an average success? Why, certainly not! Even failure to attain the higher end is nobler to the mind than the pursuit of the system of the safe man. For it is not he who sustains the fascination of our noble game, for his play is dull. It is not he who by the torch of genius fires the imagination of the young to emulate the deeds of great Chess-players, for there is no imagination in his play. It is not he who by his enterprise in great Chess undertakings commands and directs public attention and sympathy towards Chess and Chess-players, for he possesses no enterprise; and as for the boasted success of his so-called system of play (the safe man has been bold enough to say that his style of play is the outcome of a philosophic system), it admits of no other explanation than the negative one we have given above. Without wishing in the least to be disrespectful to the safe man, who may be quite an estimable person, we are tempted to say to the compilers of averages advancing a pretence of superiority on his behalf on the strength of average successes, that he has won his successes on principles somewhat analogous to those which found application in the celebrated race between the Lion and the Jackass, when the former was supposed to have been defeated by running too fast.

PROBLEMS.

By MR. J. H. BLACKBURNE.

From *Household Chess Magazine*, January 31st, 1865.

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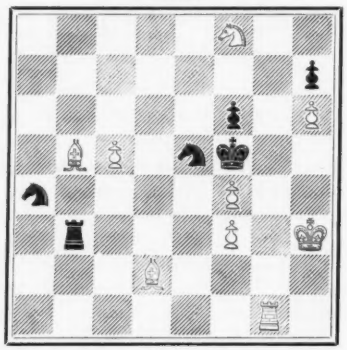

WHITE.

White to play and mate in three moves.

From *Household Chess Magazine*, March 31st, 1865.

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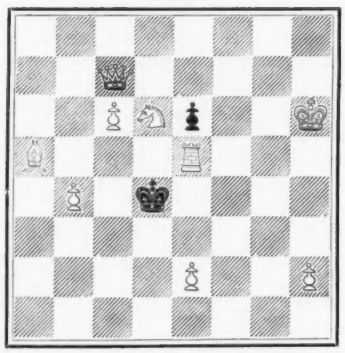

WHITE.

White to play and mate in three moves.

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